

LuK Lamellen und Kupplungsbau Be-  
teiligungs KG

Industriestraße 3

77815 Bühl

0790

### Patentansprüche

- 5 1. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem nachgeschalteten Getriebe, wobei zwischen einer Kurbelwelle der Brennkraftmaschine und einer Eingangswelle des Getriebes ein geteiltes Schwungrad mit zumindest zwei gegeneinander entgegen der Wirkung einer Energiespeichervorrichtung relativ verdrehbaren Massen angeordnet ist und zumindest eine der Massen mit der Kurbelwelle und zumindest eine Masse mit einer Eingangswelle des Getriebes unter Zwischenschaltung einer Reibungskupplung verbindbar ist.
- 15 2. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, wobei zwischen einer Kurbelwelle der Brennkraftmaschine und einer Eingangswelle des Getriebes ein hydrodynamischer Drehmomentwandler angeordnet ist und dieser hydrodynamische Drehmomentwandler mittels einer Wandlerüberbrückungskupplung überbrückbar ist.
- 20 3. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, wobei zwischen einer Kurbelwelle der Brennkraftmaschine und zumindest einer Eingangswelle des Getriebes zumindest eine Reibungskupplung vorgesehen ist, die mittels eines hydraulischen Ausrücksystems, zumindest bestehend aus einem hydraulischen Nehmerzylinder, einem hydraulischen Geberzylinder und einer diese verbindenden hydraulischen Leitung, betätigt wird.
- 25 4. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, sowie einer eine Kurbelwelle der Brennkraftmaschine und eine Getriebeeingangswelle des Getriebes verbindende Drehmomentübertragungseinrichtung, wie Reibungskupplung oder hydrodynamischer Drehmomentwandler, wobei in zumindest eine Wange der Kurbelwelle ein Schwingungstilger zur Verminderung von Drehungleichförmigkeiten der Brennkraftmaschine vorgesehen ist.
- 30

5. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem bezüglich seiner Übersetzung kontinuierlich verstellbaren Umschlingungsmittelgetriebe, bestehend aus einem Getriebeeingangsteil mit einem ersten Kegelscheibensatz und einem Getriebeausgangsteil, mit einem zweiten Kegelscheibensatz sowie einem endlosen, beide Kegelscheibensätze umschlingenden Umschlingungsmittel, wobei jeweils eine Kegelscheibe eines Kegelscheibensatzes gegenüber einer zweiten Scheibe des Kegelscheibensatzes axial mittels hydraulischen Drucks verlagerbar ist.
6. Kraftfahrzeug mit einem Antriebsstrang, insbesondere nach Anspruch 5, dadurch gekennzeichnet, dass das Umschlingungsmittel aus einer Kette gebildet ist, die aus in Laufrichtung hintereinander folgenden Laschenverbänden besteht, die quer zur Laufrichtung von Stegen durchdrungen werden, wobei diese Stege an ihren axialen Enden jeweils in Reibeingriff mit den beiden Kegelscheiben eines Kegelscheibenpaares stehen.
7. Kraftfahrzeug mit einem Antriebsstrang, insbesondere nach Anspruch 5, dadurch gekennzeichnet, dass das kontinuierlich verstellbare Umschlingungsmittelgetriebe Teil eines leistungsverzweigten Getriebes ist.
8. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, wobei das Getriebe ein Kurbelgetriebe ist.
9. Kraftfahrzeug mit einem Antriebsstrang, einer Brennkraftmaschine und einem Getriebe, wobei das Getriebe ein automatisiertes Schaltgetriebe mit zumindest einer Getriebeeingangswelle ist und die Schaltvorgänge mittels einer Aktorik erfolgen, die zumindest aus einem Elektromotor gebildet ist.
10. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine mit einer Kurbelwelle und einem Getriebe mit zumindest einer Getriebeeingangswelle, wobei eine Elektromaschine mit der Kurbelwelle und/oder der Getriebeeingangswelle koppelbar ist.

11. Kraftfahrzeug mit einer Pumpe zur hydraulischen Versorgung von Lenkungssystemen und/oder Fahrwerkssystemen und/oder Getriebesystemen, insbesondere Flügelzellenpumpe oder Radialkolbenpumpe oder Zahnradpumpe, wobei die Pumpe Einrichtungen zur Regelung des Volumenstroms aufweist.

5

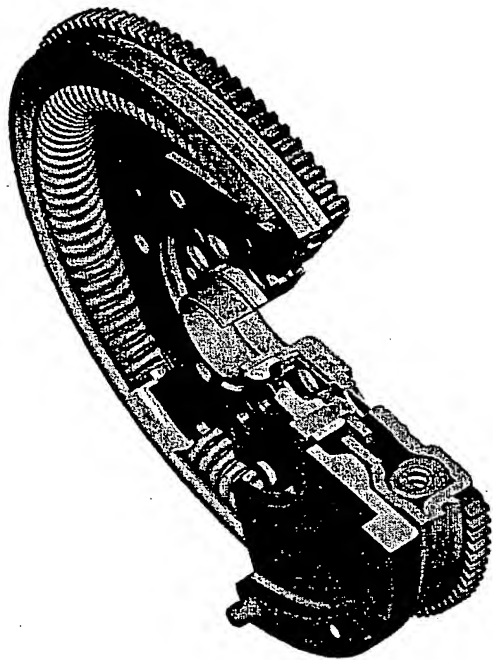
12. Kraftfahrzeug mit einer Pumpe, wie Flügelzellenpumpe oder G-Rotor-Pumpe oder Rollenzellenpumpe, insbesondere zur Schmierölversorgung eines Verbrennungsmotors, wobei der Volumenstrom der Pumpe temperaturabhängig beeinflussbar ist.

10

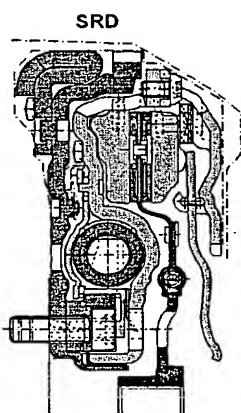
13. Kraftfahrzeug mit einer Klimaanlage mit Klimakompressor, wie Schwenkringkompressor, insbesondere zur Verwendung von CO<sub>2</sub> als Kältemittel, wobei die Klimaanlage zur Kühlung und/oder Erwärmung durch Verwendung als Wärmepumpe einsetzbar ist.

15

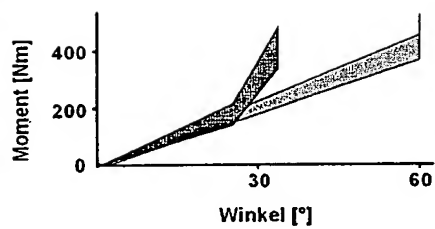
14. Kraftfahrzeug mit einem Getriebe, insbesondere automatisiertes Schaltgetriebe, wobei verschiedene Schalt- und Kupplungsstrategien hydraulisch und/oder elektromotorisch ausgeführt werden können.



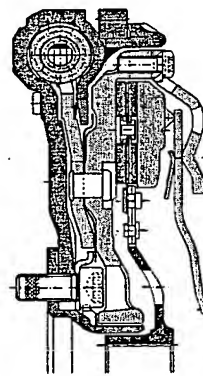
Figur 1



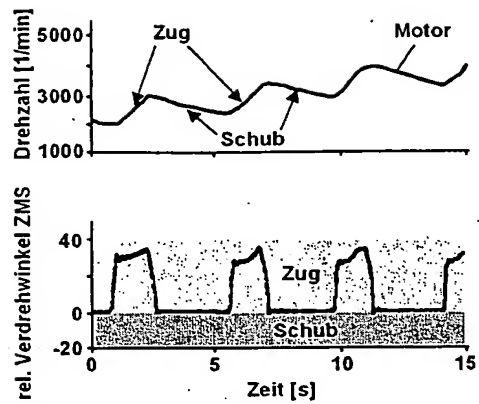
Figur 2



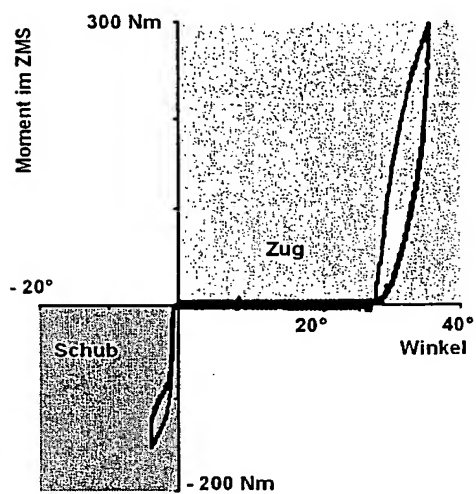
Standard-ZMS



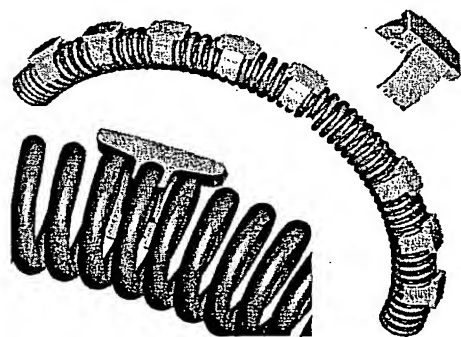




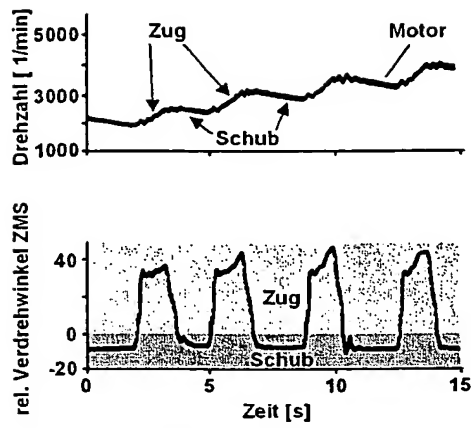
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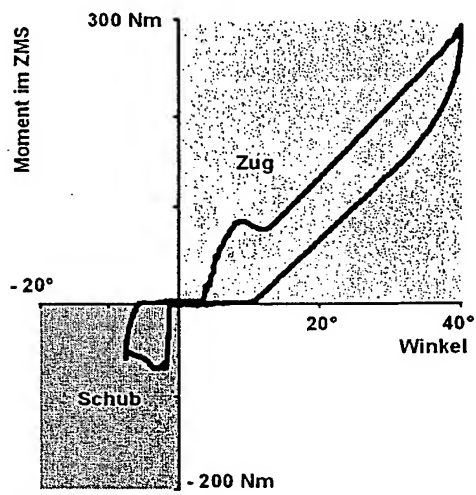
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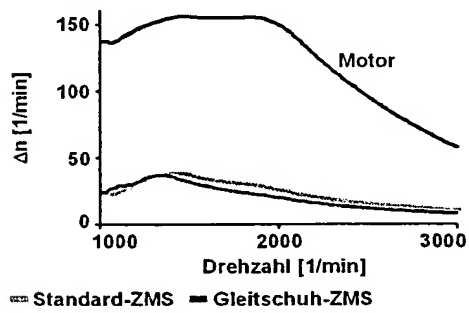
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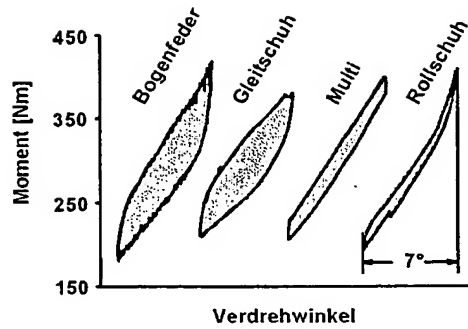
Figur 6



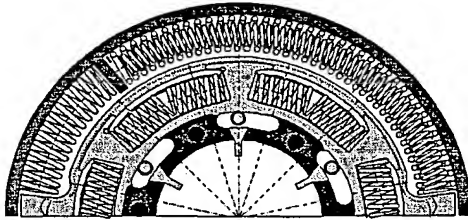
Figur 7



Figur 8



Figur 9

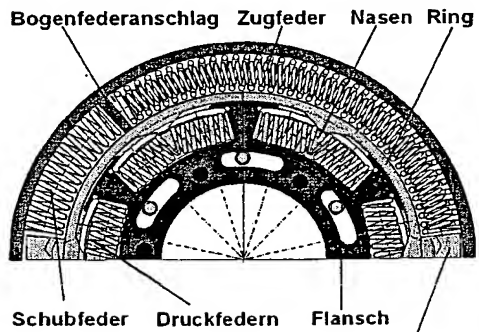


**Außendämpfer:**

- keine vorgespannte Bogenfeder
- $M_{\text{Anschlag}} < M_{\text{Motor}}$

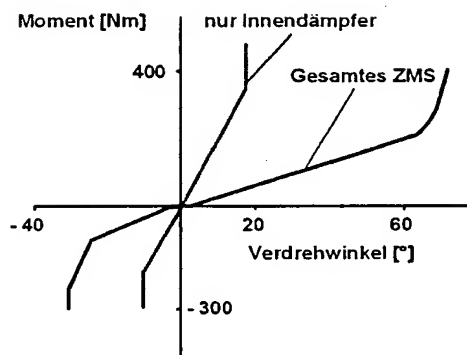
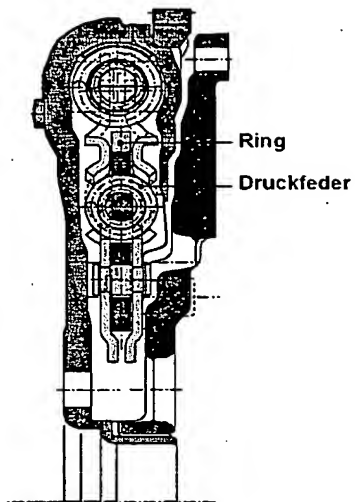
**Innendämpfer:**

- reibungsfrei
- Serienschaltung 2er Druckfedern
- $M_{\text{Anschlag}} < M_{\text{Motor}}$

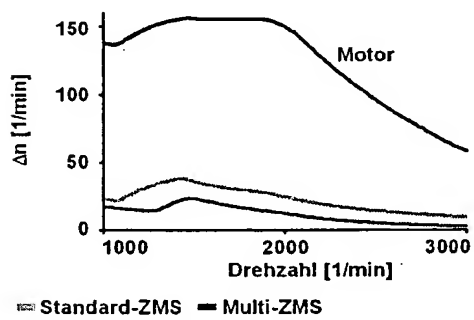


Seitenbleche für Innendämpfer mit  
Flanschlappen für Außendämpfer

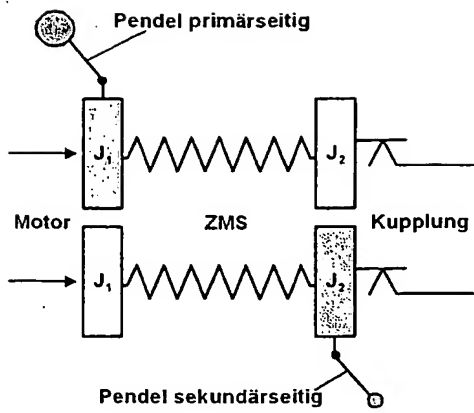
Figur 10



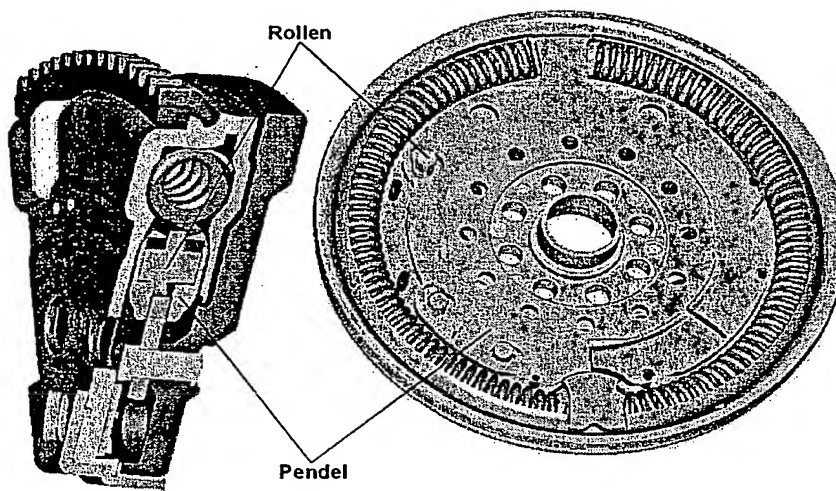
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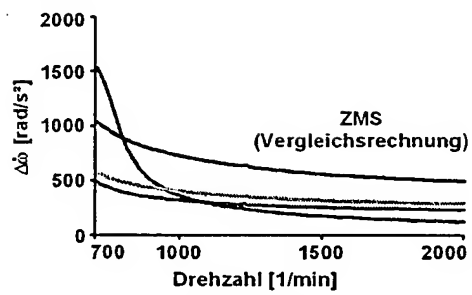
Figur 12



Figur 13

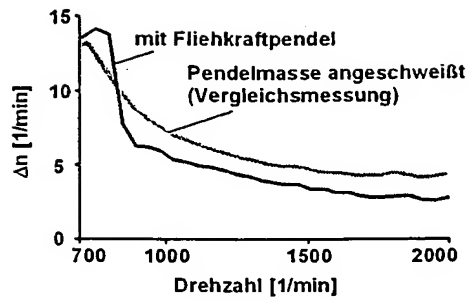


Figur 14

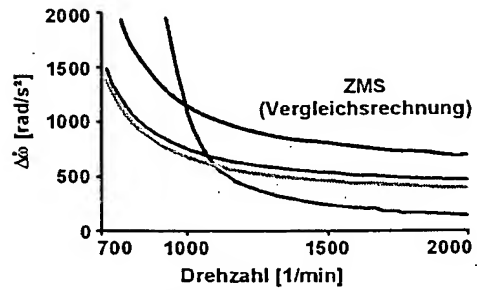


Eigenfrequenz abgestimmt auf:  
 — 3. Ordnung — 3,1. Ordnung — 3,2. Ordnung

Figur 15



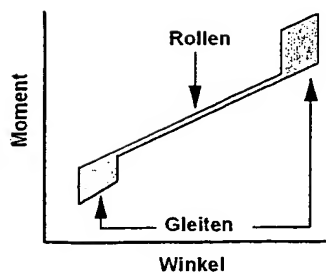
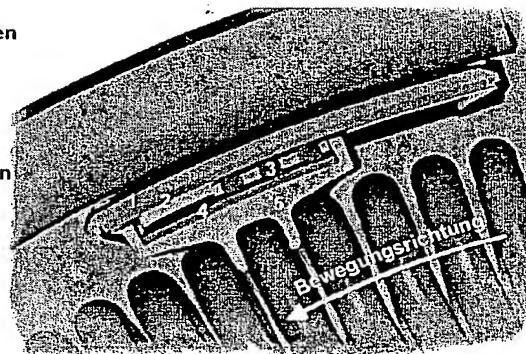
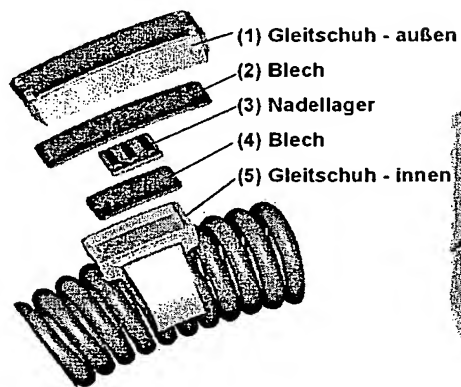
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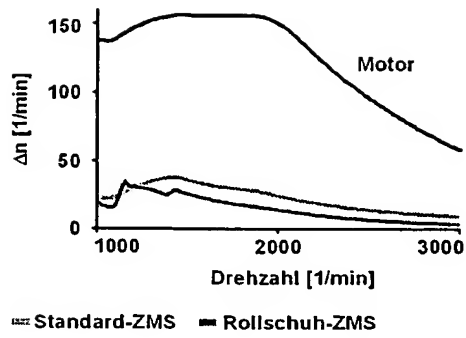
Eigenfrequenz abgestimmt auf:

■ 2. Ordnung    ⇌ 2,2. Ordnung    ■ 2,5. Ordnung

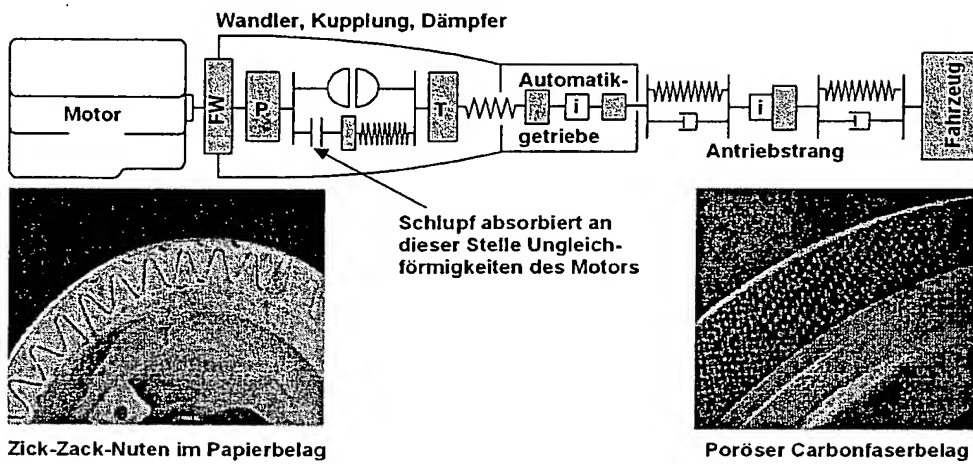
Figur 17



Figur 18



Figur 19

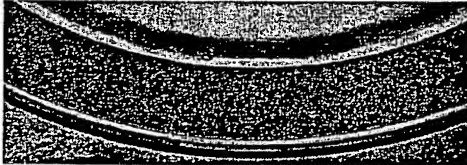


Figur 20

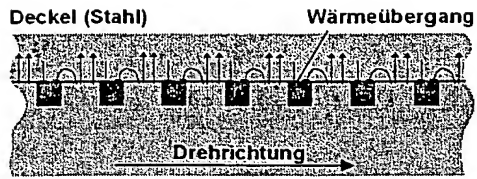
Genuteter Deckel



Ungenuteter Reibbelag



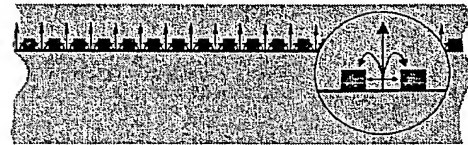
Figur 21



Kolbenblech (Stahl)

Wärmeübergang in den Deckel und dann  
in das Öl der sich vorbeibewegenden Nuten

Genuteter Deckel (Stahl)

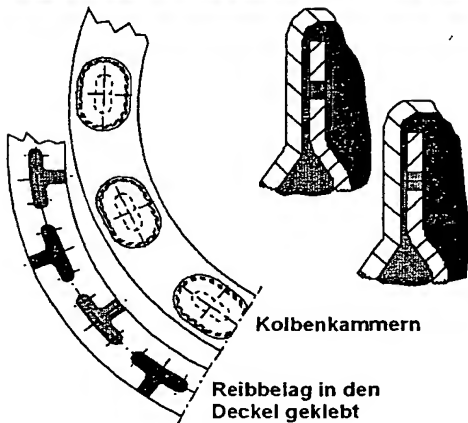
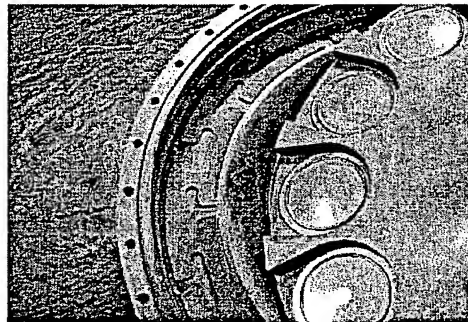


Kolbenblech (Stahl)

Mehr Nuten bedeutet besserer Wärmeüber-  
gang bei gleichbleibender Durchflußrate

■ Ölnuten      ■ Reibbelag (Wärmeisolator)

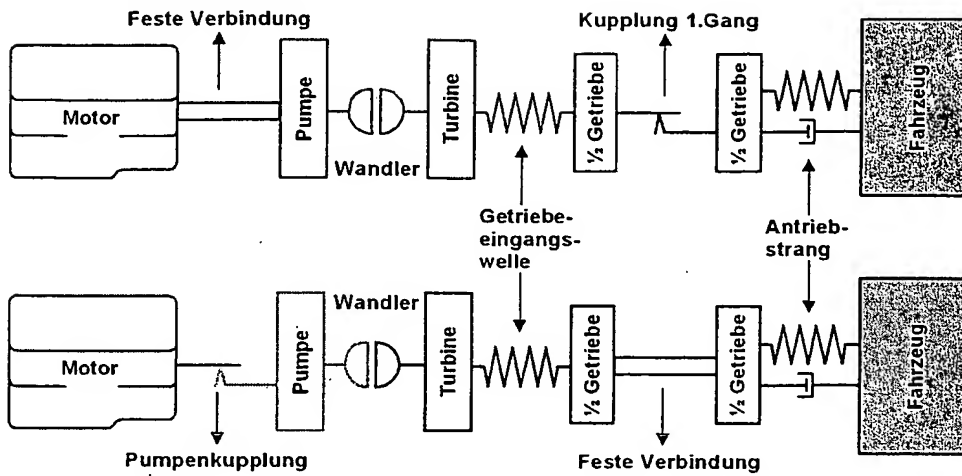
Figur 22



Figur 23

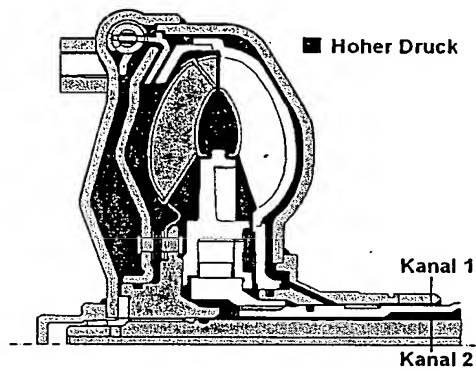
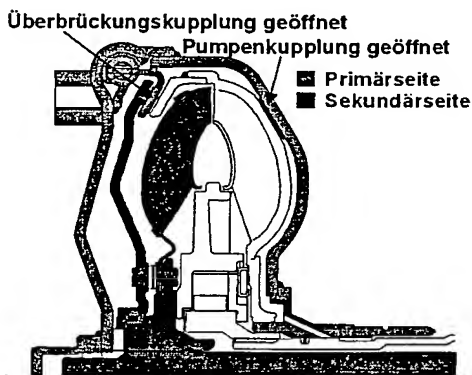


# Schaltvorgang von Leerlauf nach "D"

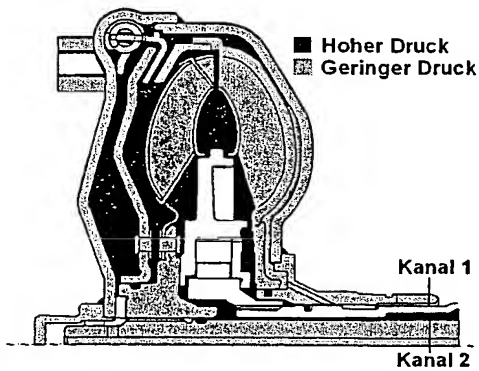
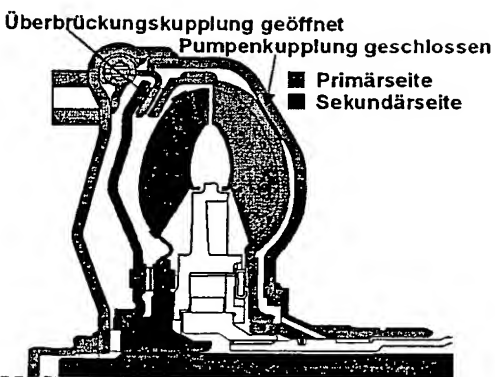


## Betätigung der Kupplung zwischen Deckel und Pumpe

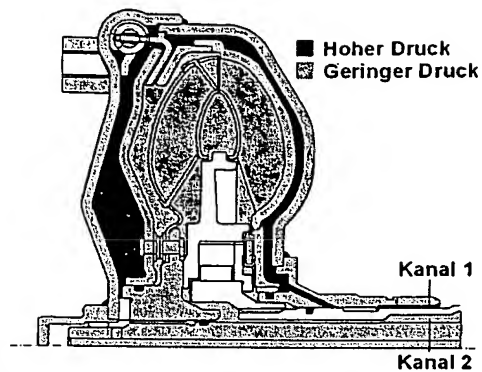
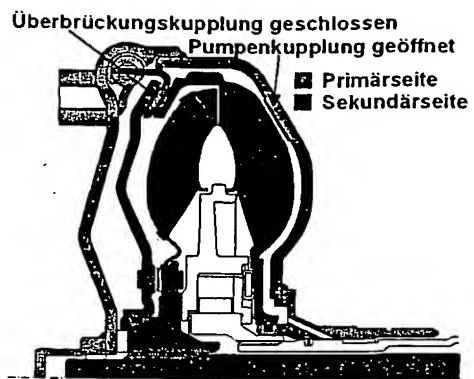
Figur 24



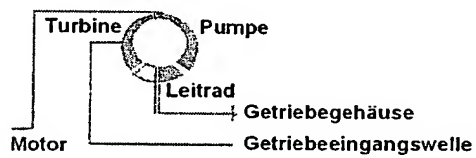
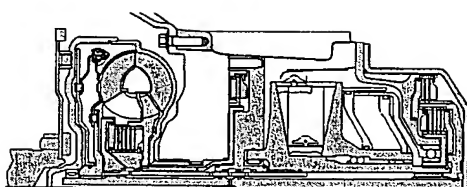
Figur 25



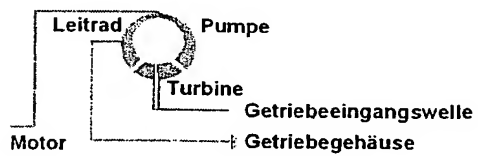
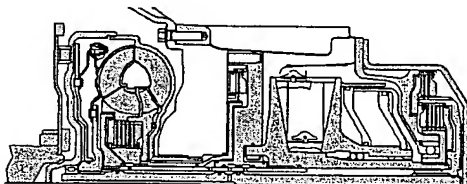
Figur 26



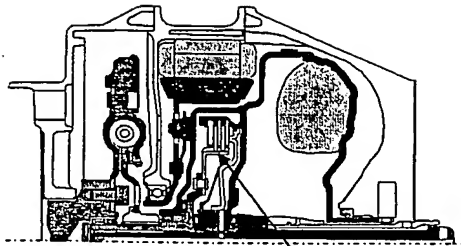
Figur 27



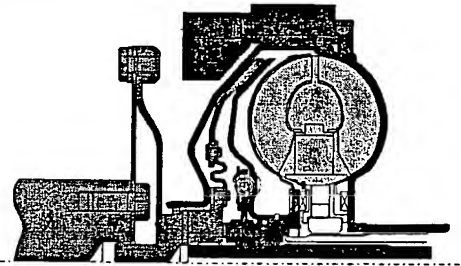
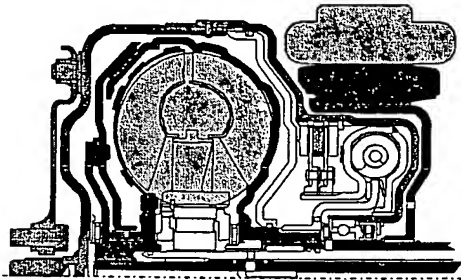
Figur 28



Figur 29

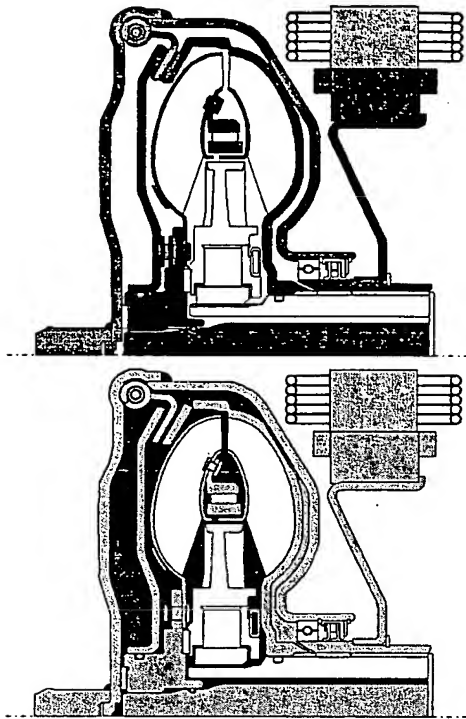


Kupplung zur Abkopplung des  
Verbrennungsmotors

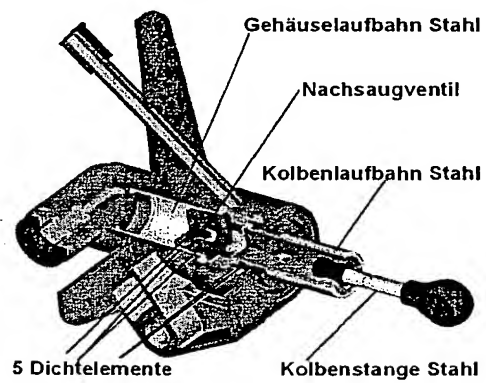


■ E-Maschine    ■ Wandler

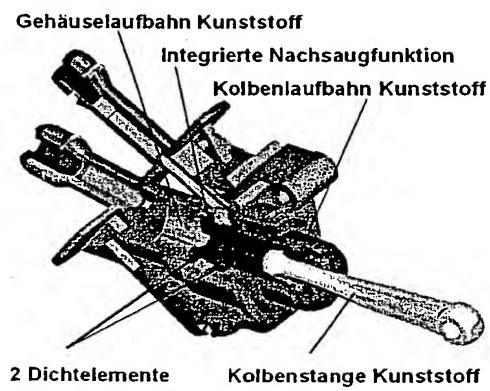
Figur 30



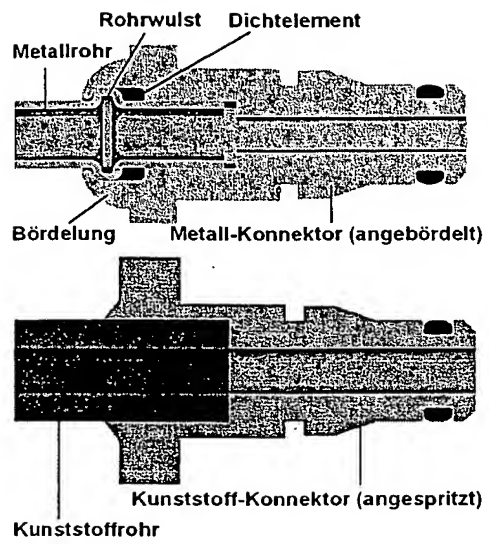
Figur 31



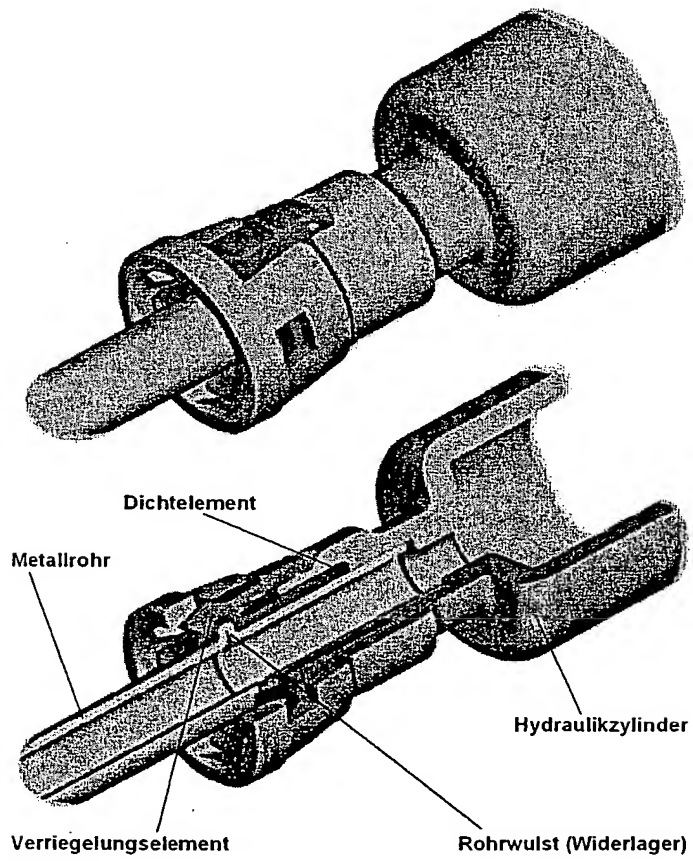
Figur 32



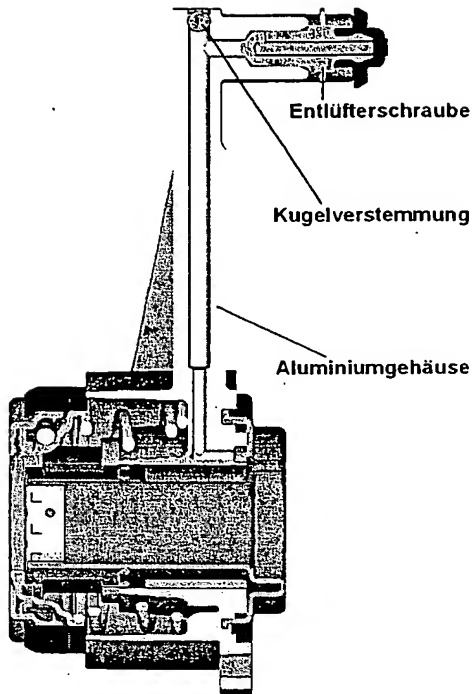
Figur 33



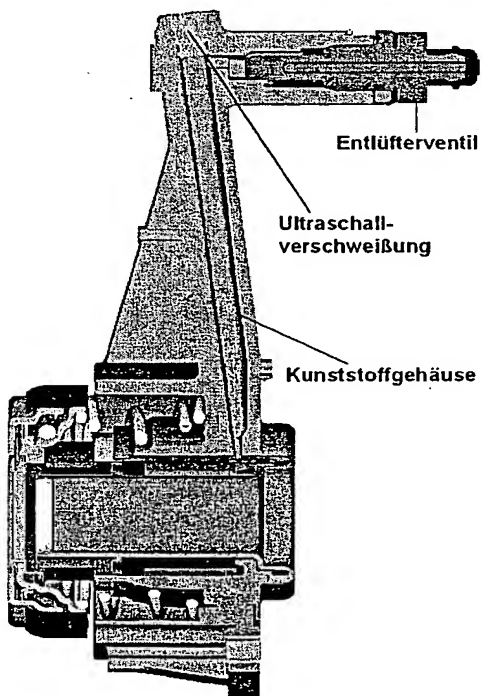
Figur 34



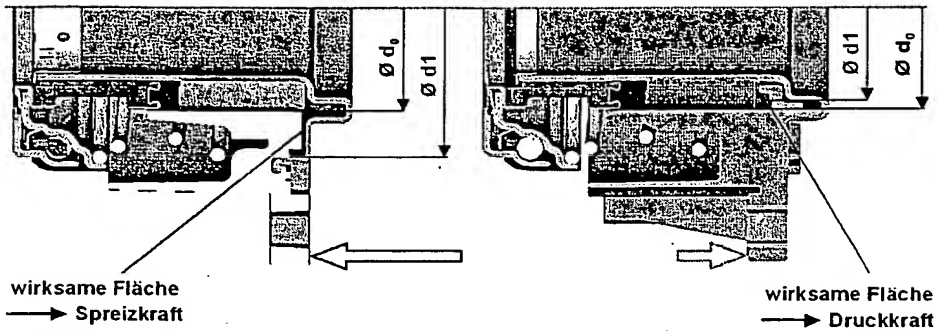
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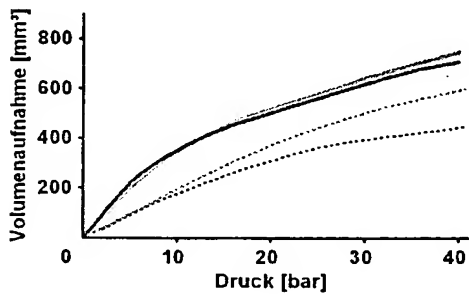
Figur 36



Figur 37



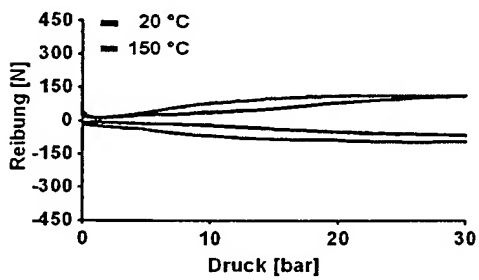
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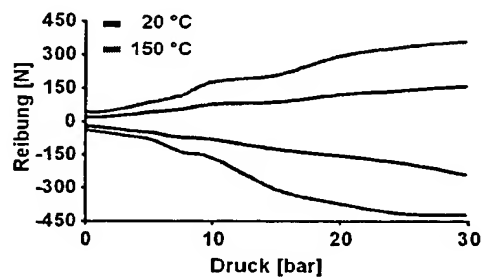
- Kunststoff - CSC +80 °C
- Kunststoff - CSC -40 °C
- Aluminium - CSC +80 °C
- Aluminium - CSC -40 °C

Figur 39

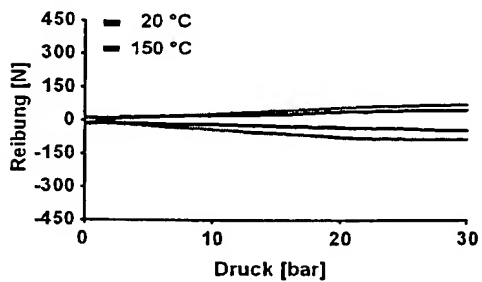
Aluminium - CSC Neuzustand



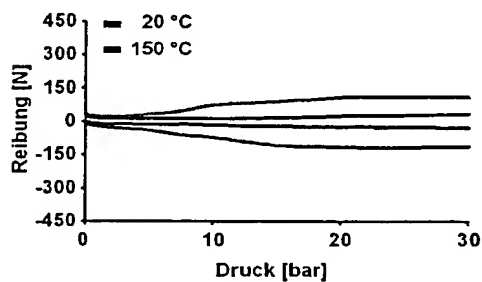
Aluminium - CSC nach Laufstrecke



Kunststoff - CSC Neuzustand



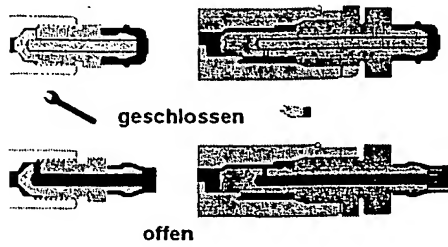
Kunststoff - CSC nach Laufstrecke



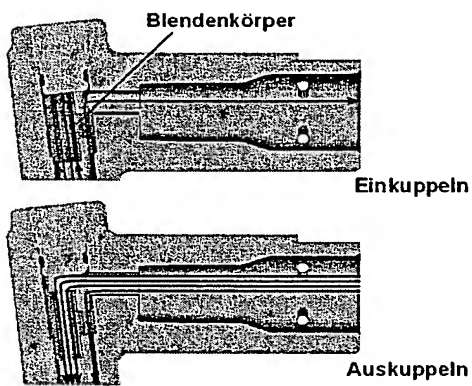
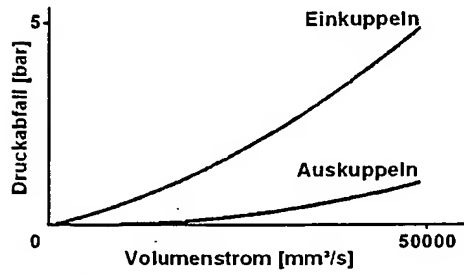
Figur 40

Entlüfterschraube

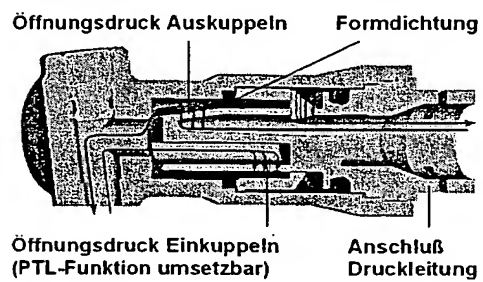
Entlüfterventil



Figur 41

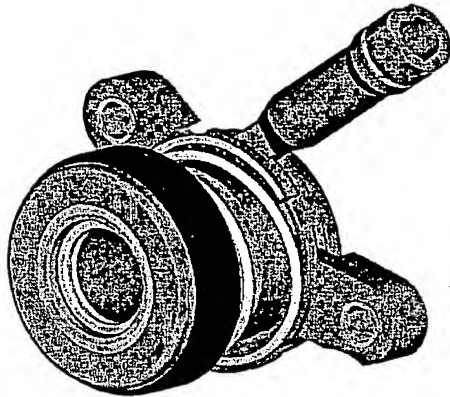


Figur 42

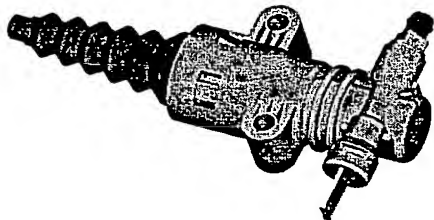


Figur 43

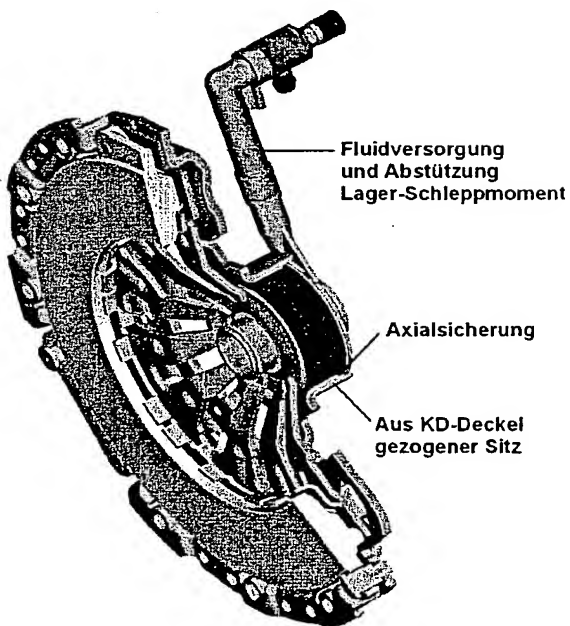




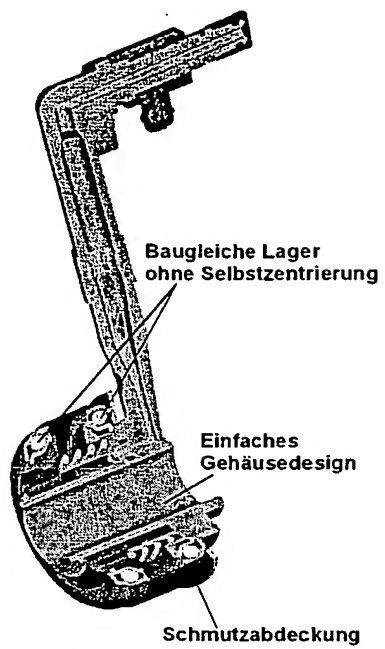
Figur 44



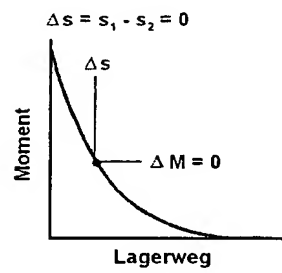
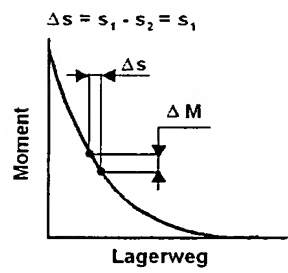
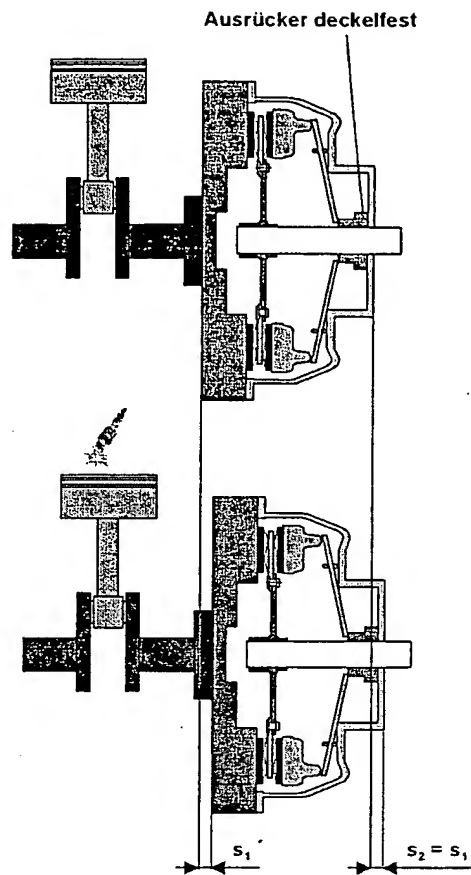
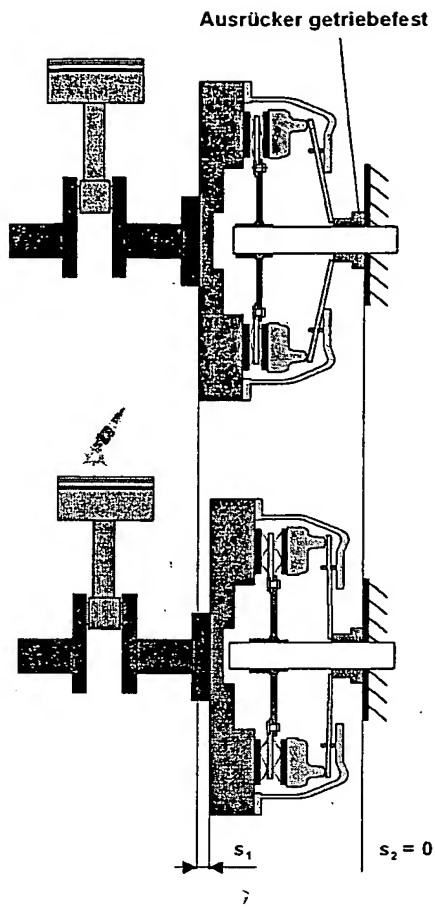
Figur 45



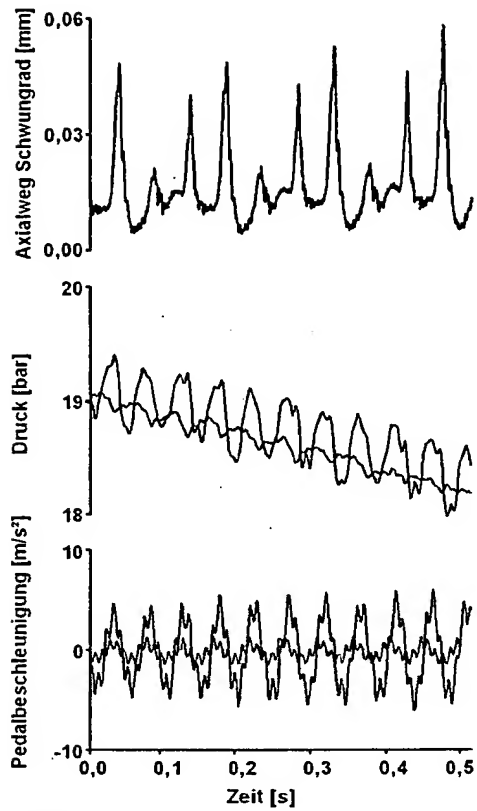
Figur 46



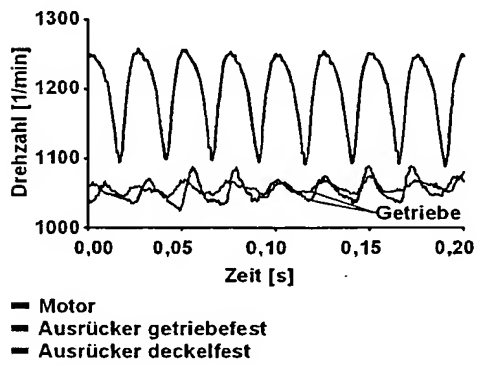
Figur 47



Figur 48



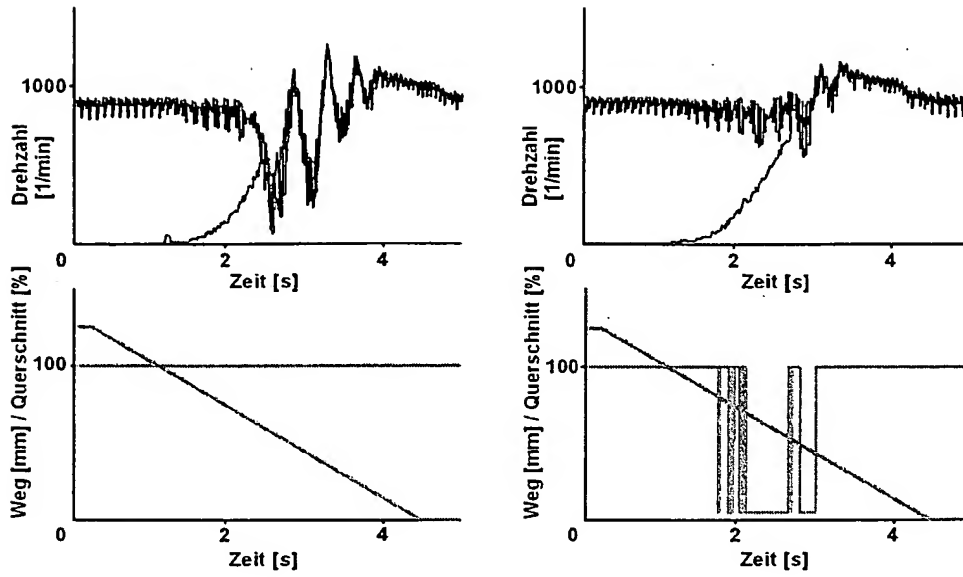
Figur 49



Figur 50

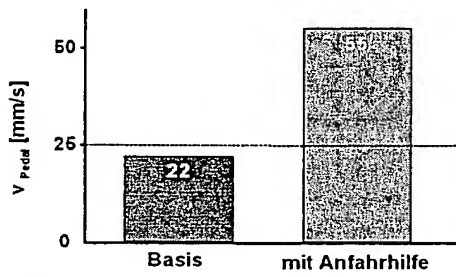
Ohne Anfahrhilfe

Mit Anfahrhilfe

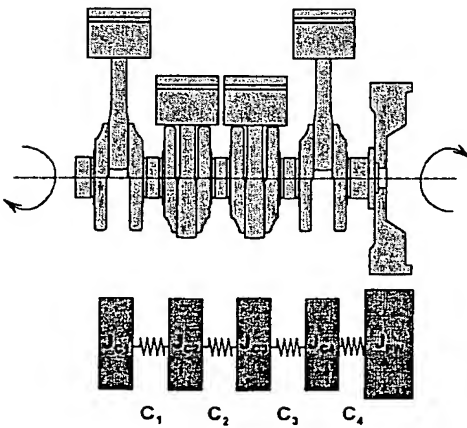


— Motor    - - - Getriebe    ... Pedalweg    - · - Leitungsquerschnitt

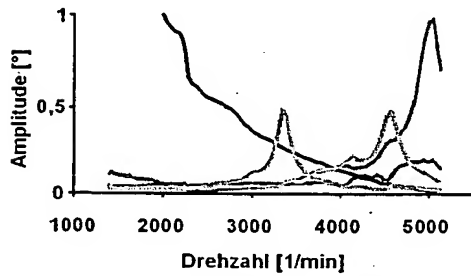
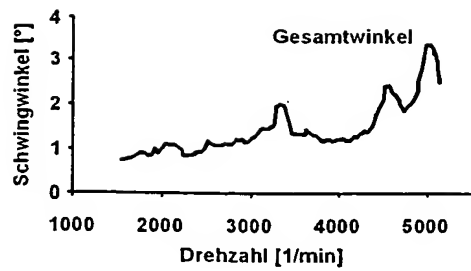
Figur 51



Figur 52

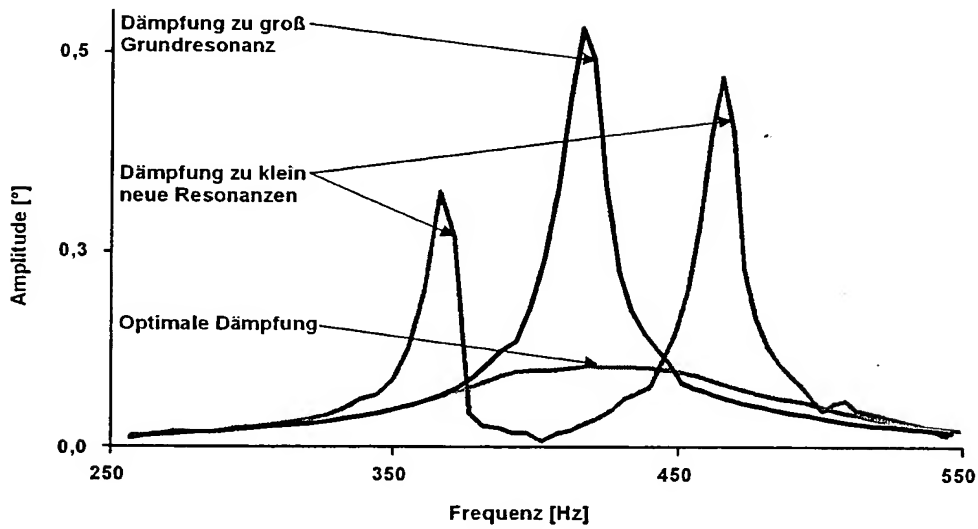


Figur 53

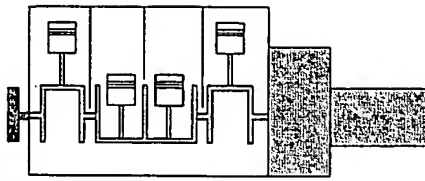


■ 2,5.Ordnung ■ 5,0.Ordnung ■ 7,5.Ordnung  
■ 4,5.Ordnung ■ 5,5.Ordnung

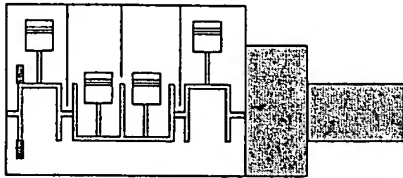
Figur 54



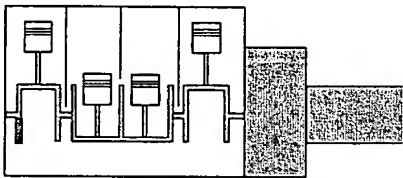
Figur 55



ausenliegender Dämpfer

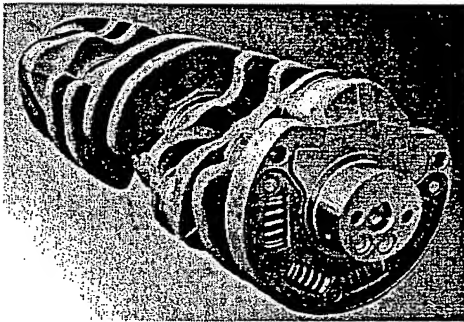


interner Dämpfer deutsches Patent 536 929

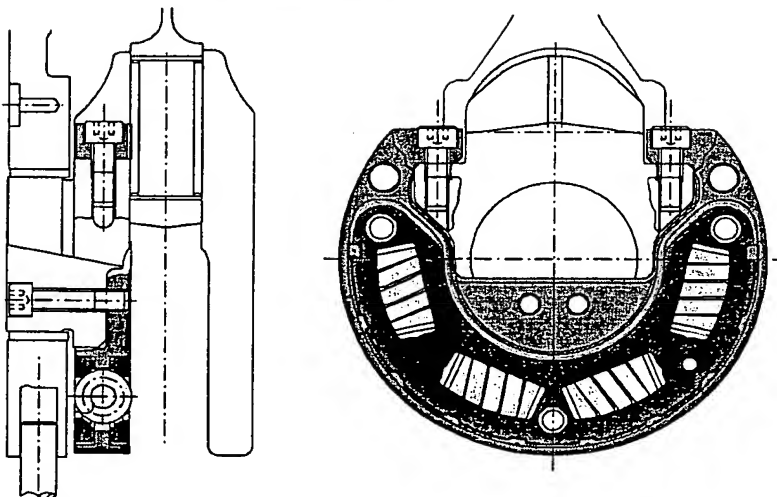


interner Dämpfer ICD

Figur 56

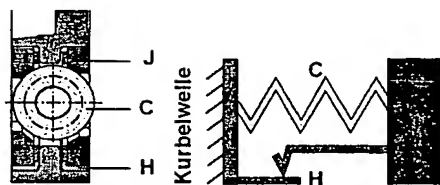
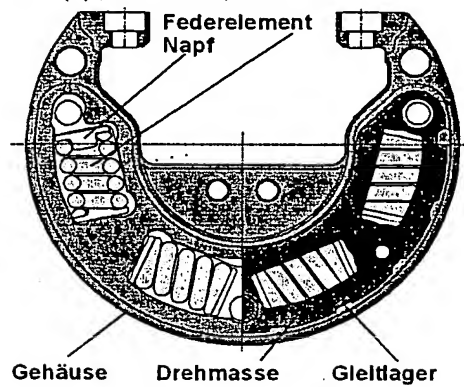


Figur 57

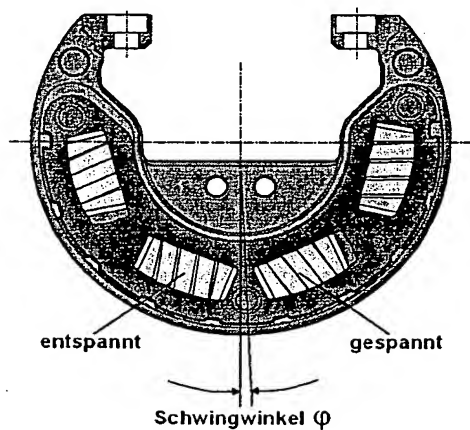


Figur 58

$$H = f(n) ; C = \text{const} ; J = \text{const} .$$

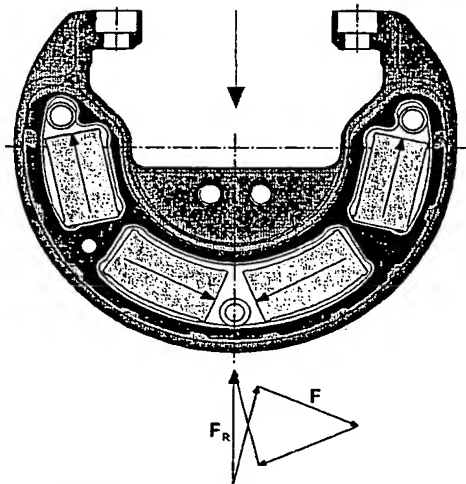


Figur 59



Figur 60

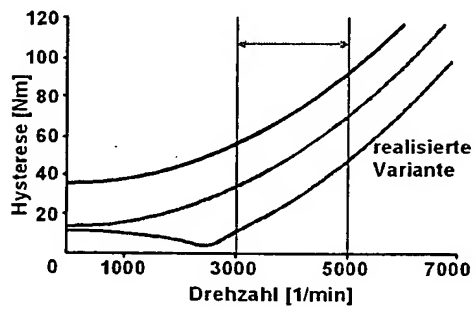




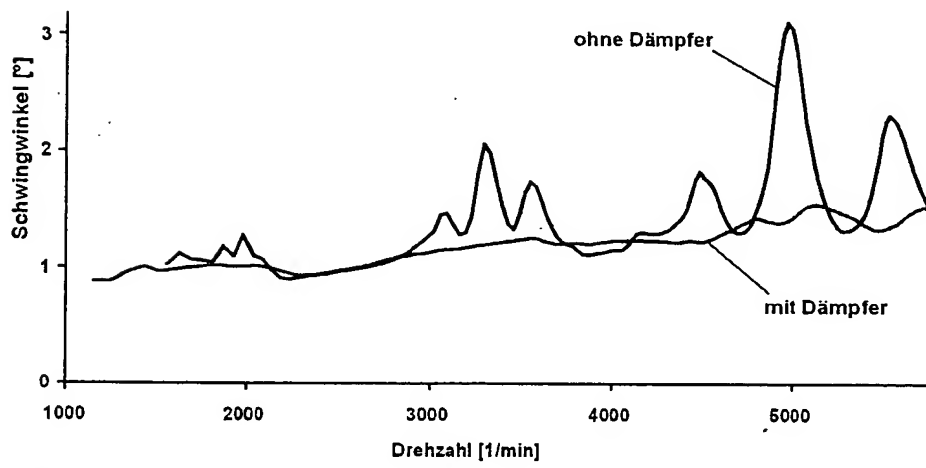
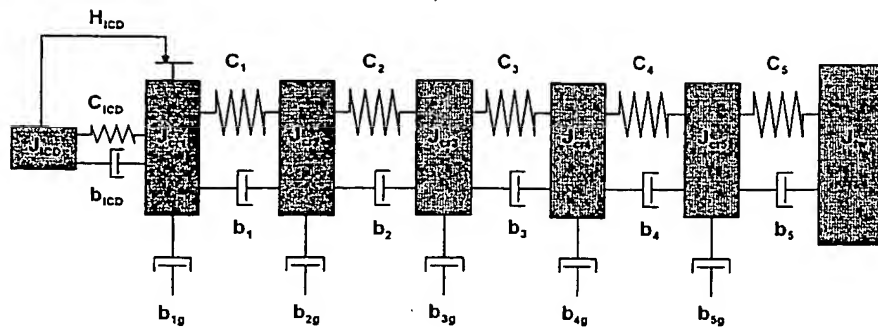
$F$  = Federvorspannung  
 $F_R$  = Resultierende der Federvorspannung  
 $\nabla$  = Fliehkraft

Figur 61

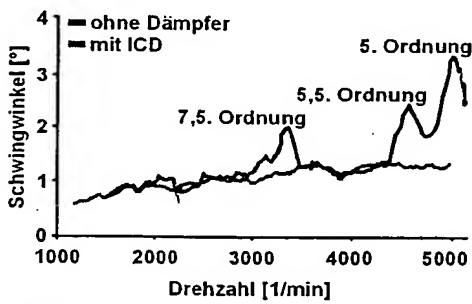
Hauptarbeitsbereich



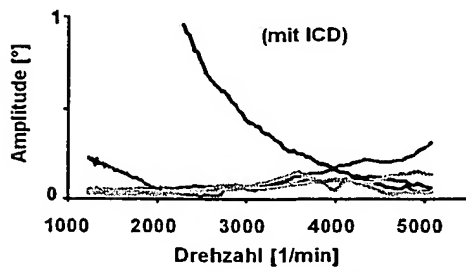
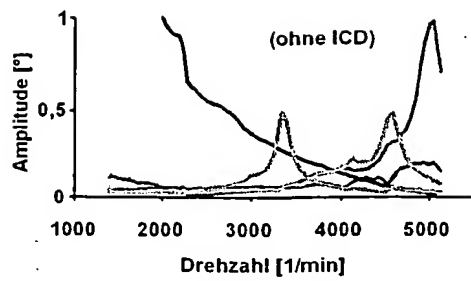
Figur 62



Figur 63

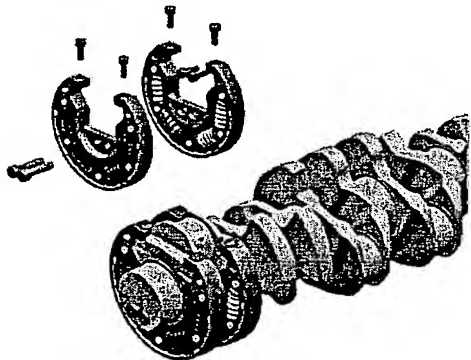


Figur 64

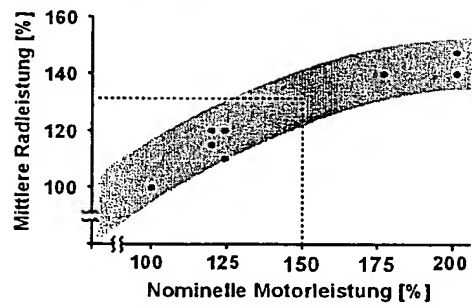


— 2,5.Ordnung — 5,0.Ordnung — 7,5.Ordnung  
— 4,5.Ordnung — 5,5.Ordnung

Figur 65

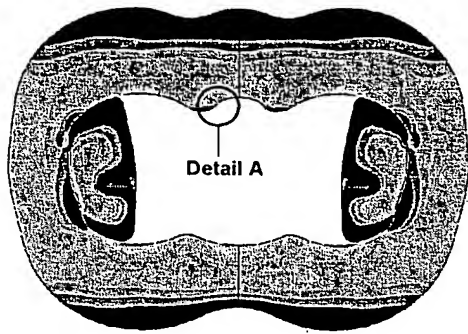


Figur 66

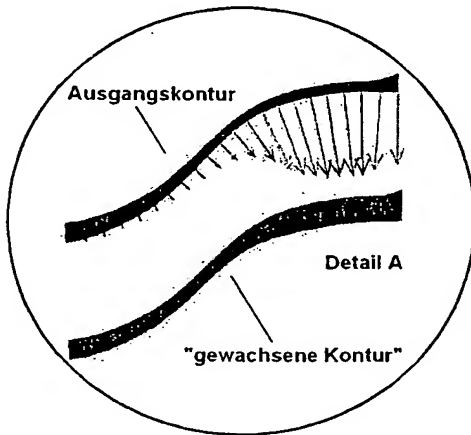


• Kundenkollektive

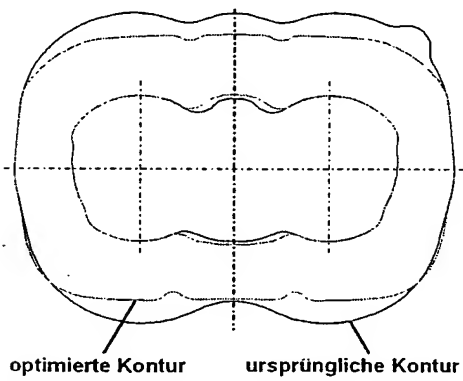
Figur 67



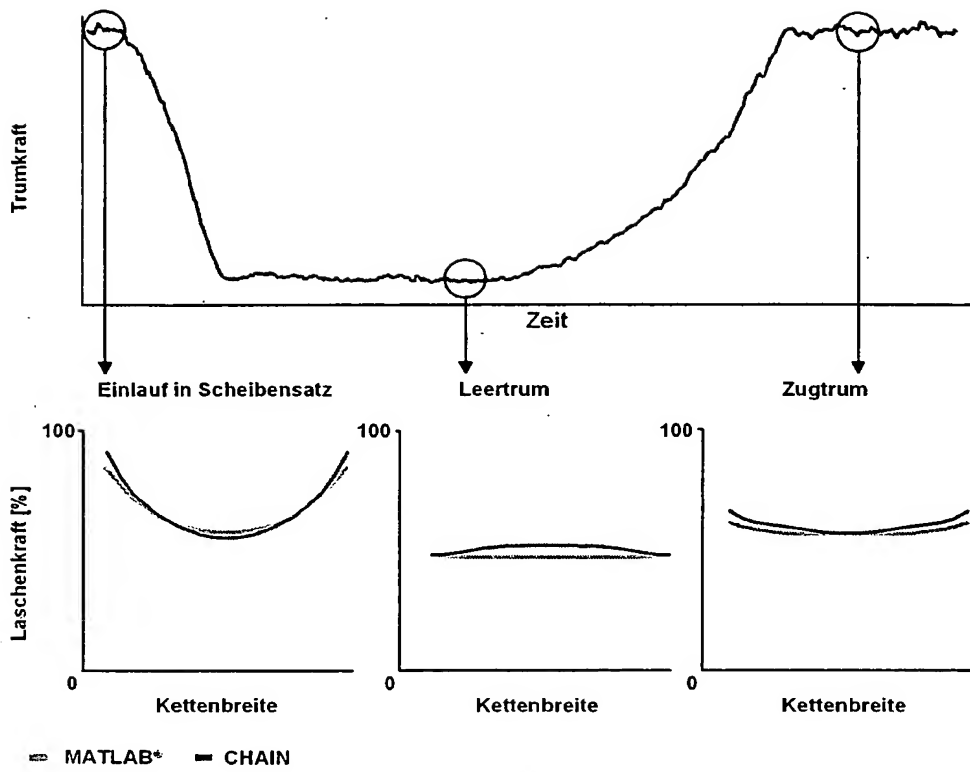
Figur 68



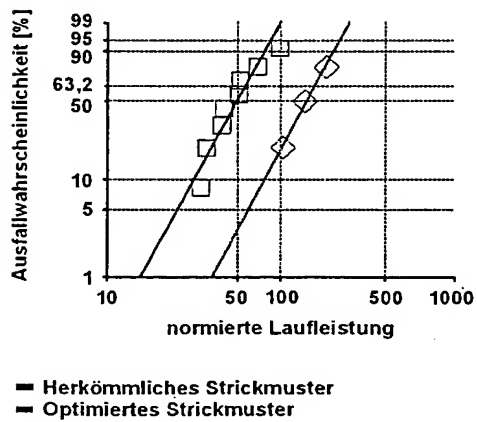
Figur 69



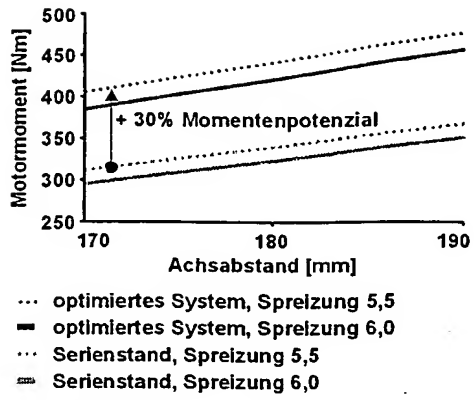
Figur 70



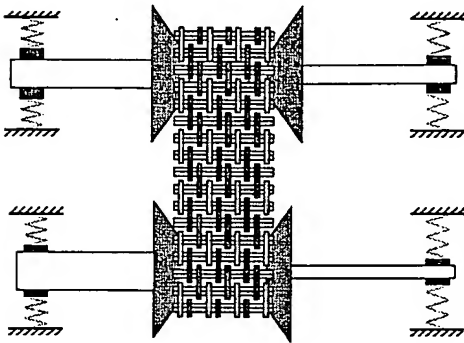
Figur 71



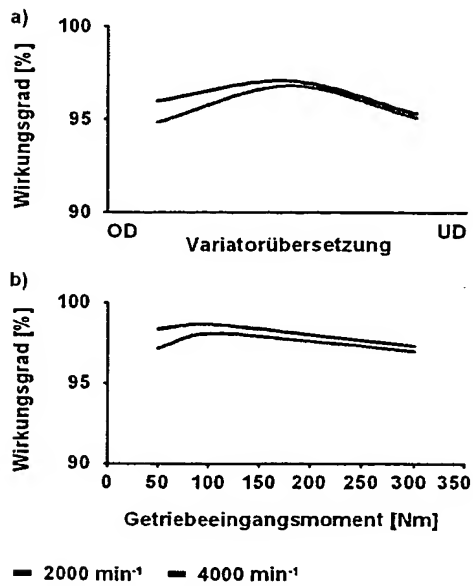
Figur 72



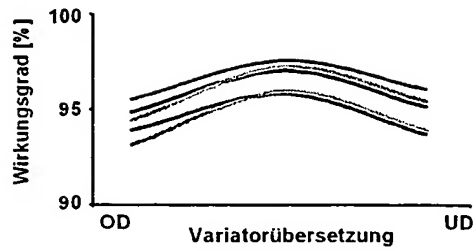
Figur 73



Figur 74



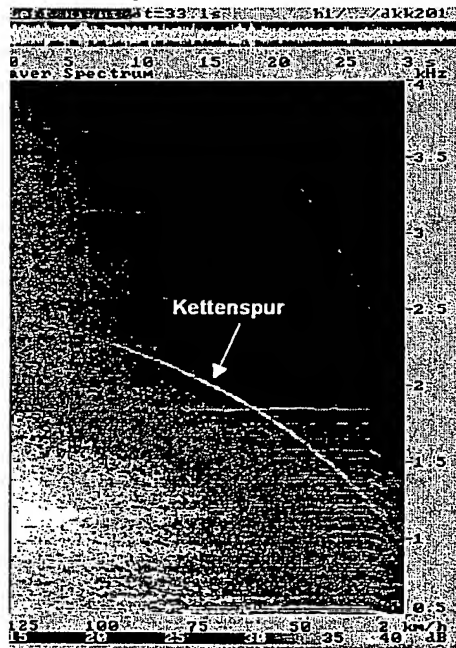
Figur 75



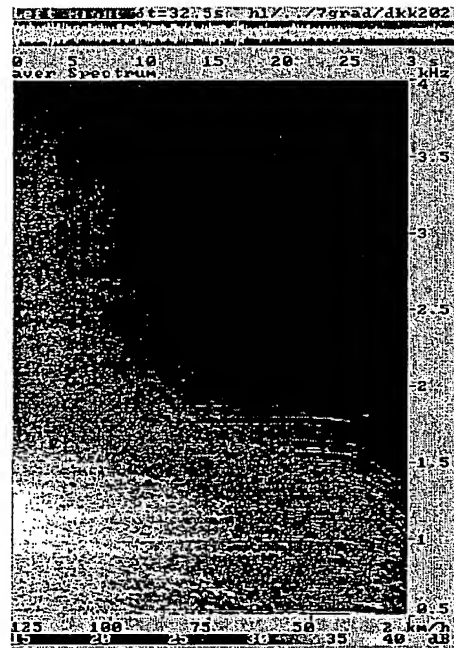
Variante		Scheibensatz- geometrie	Kette	Bemerkung
—	Basis A	ge- wölbt	37 mm	Serie multi- tronic®
—	B	11°	37 mm	-
—	C	7°	37 mm	-
—	D	ge- wölbt	37 mm „Leicht“	Welle: Ø + 2 mm
—	E	ge- wölbt	37 mm	30% Über- anpressung

Figur 76

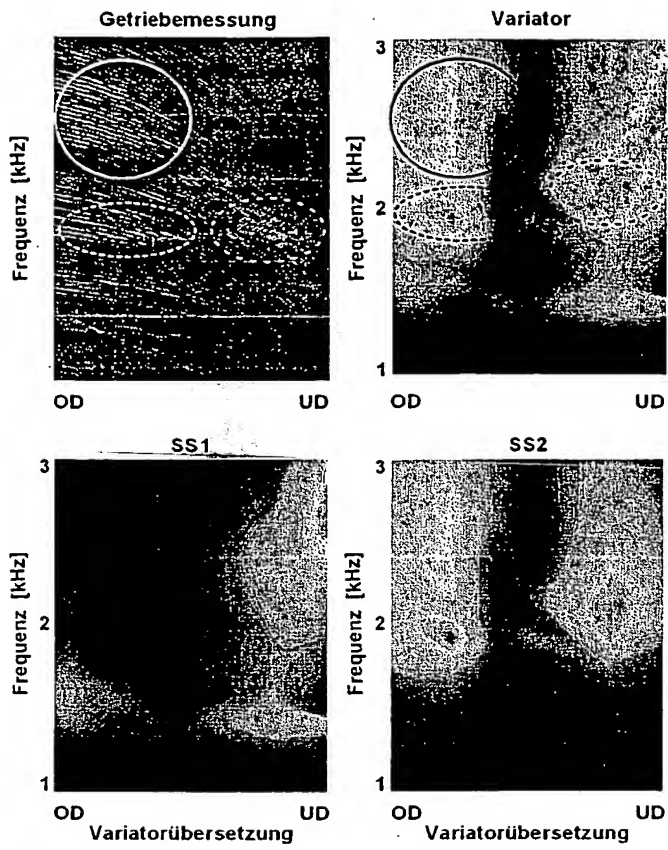
Gleichteilungskette



Random-Kette

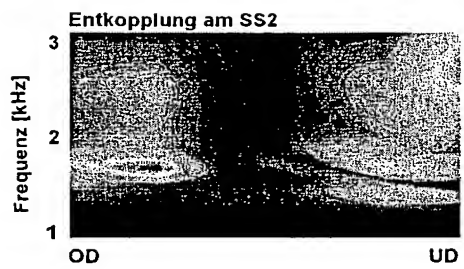
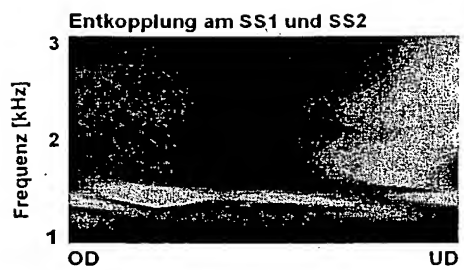
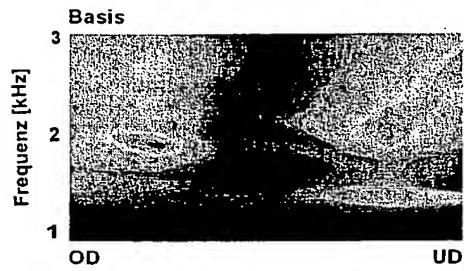
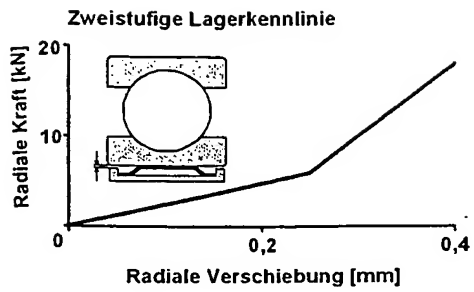


Figur 77



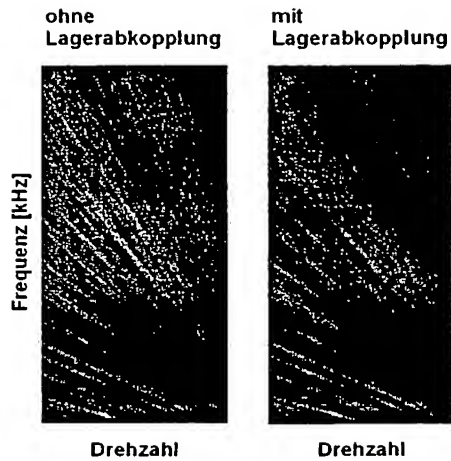
Figur 78





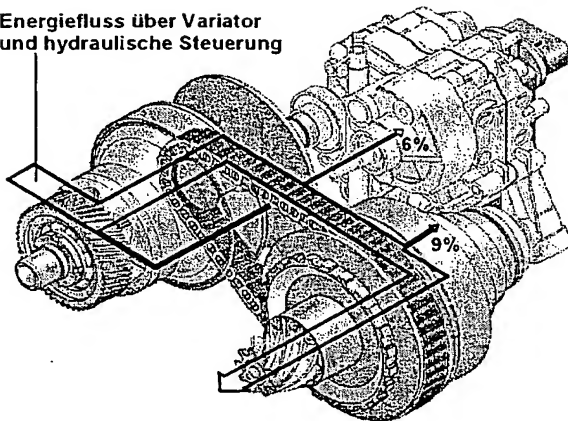
Variatorübersetzung

Figur 79

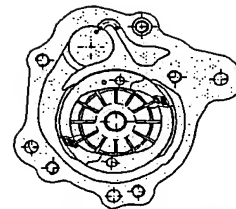


Figur 80

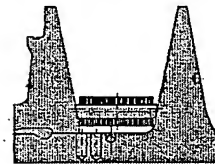
Energiefluss über Variator  
und hydraulische Steuerung



Figur 81



Hydraulische Verluste



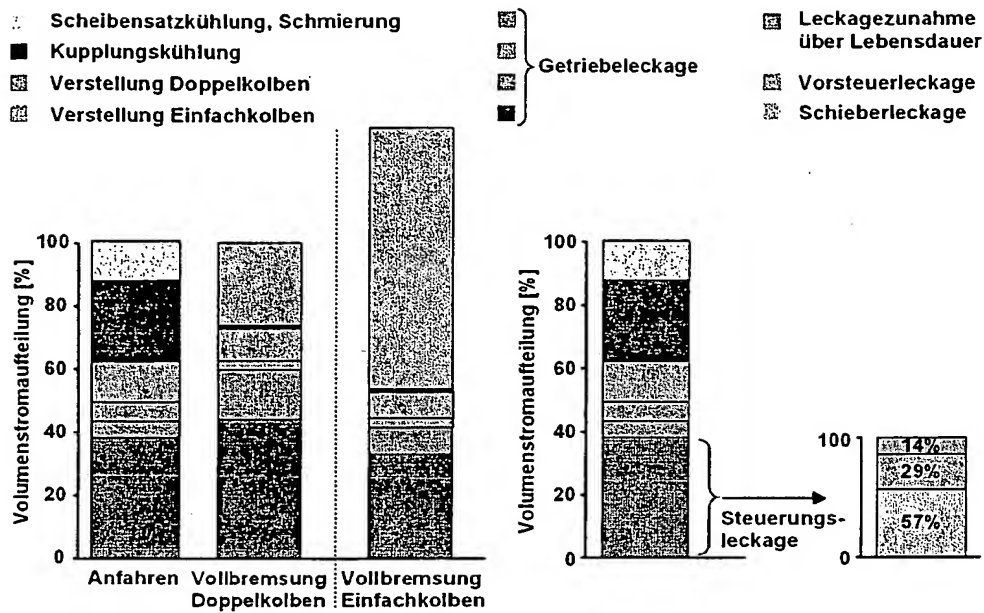
Mechanische Verluste

Geringe hydraulische Verluste =

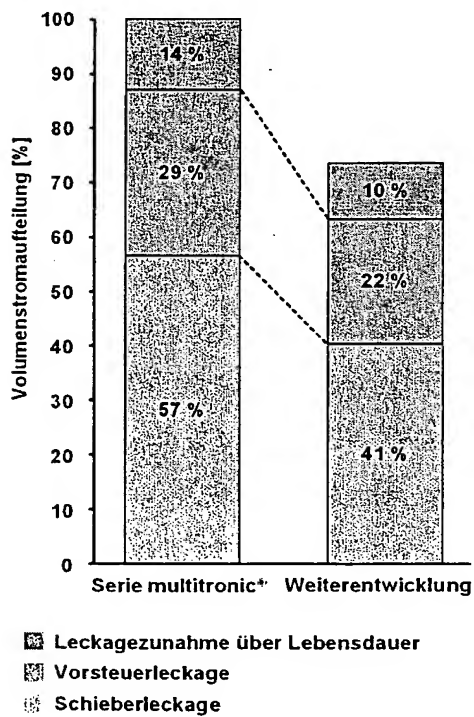
Geringes Fördervolumen X Geringer Pumpendruck

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Scheibensätze mit LuK Doppelkolben</li> <li>• Kupplungskühlung mit Saugstrahlpumpe</li> <li>• Geringe Leckage             <ul style="list-style-type: none"> <li>- Pumpe mit axialer und radialer Spaltkompensation</li> <li>- geringe Schieberzahl</li> <li>- enge Spiele und kleine Fertigungstoleranzen</li> <li>- geringe Anzahl von E-Ventilen</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• kleine Anpress-Sicherheitsfaktoren (Schlupfregelung)</li> <li>• Systemdruck abhängig vom aktuellen Motormoment</li> <li>• geringe Rückstaudrücke</li> </ul> |
|---|--|

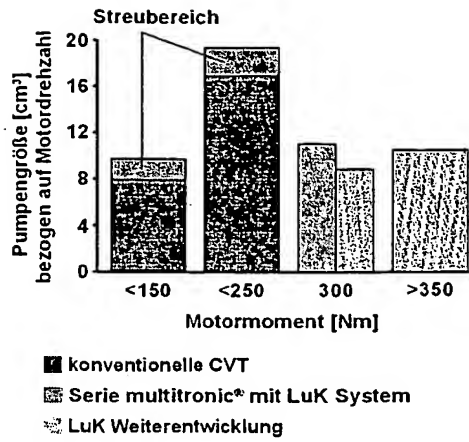
Figur 82



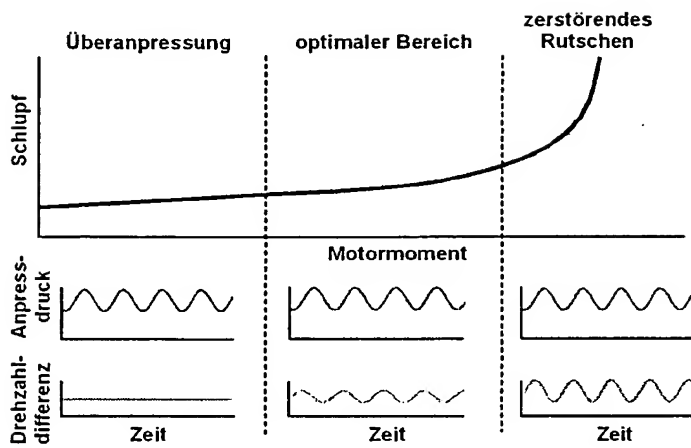
Figur 83



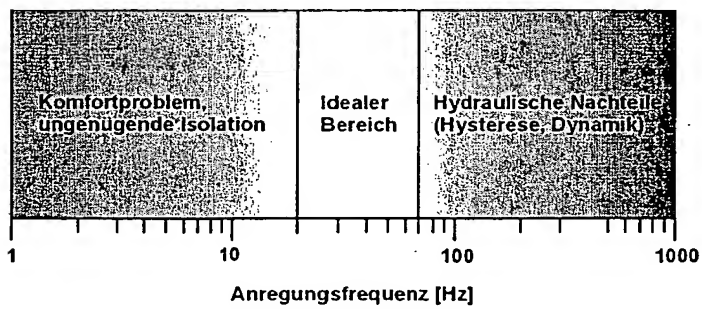
Figur 84



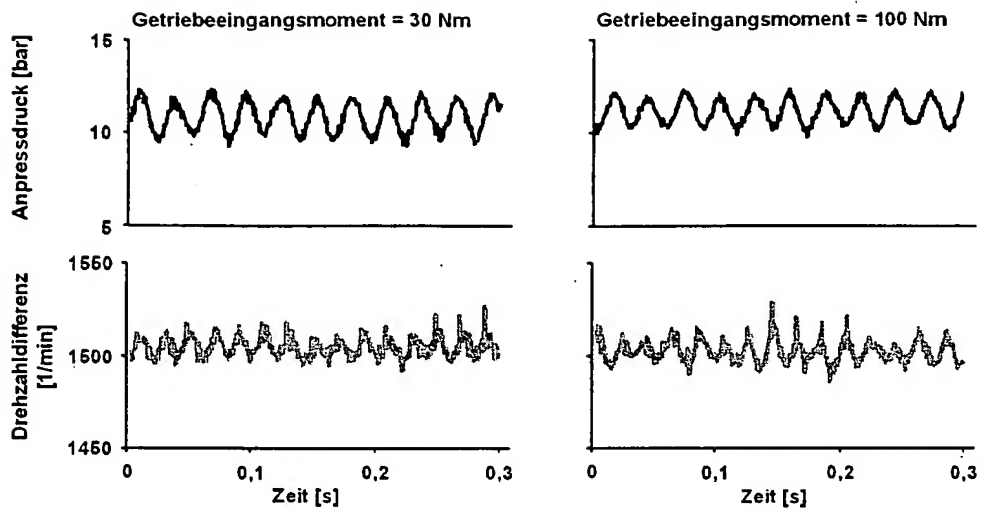
Figur 85



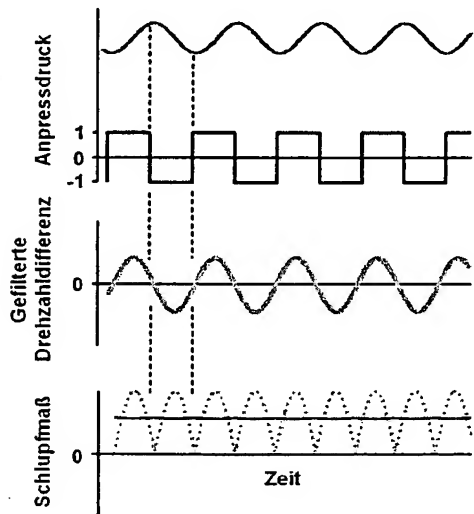
Figur 86



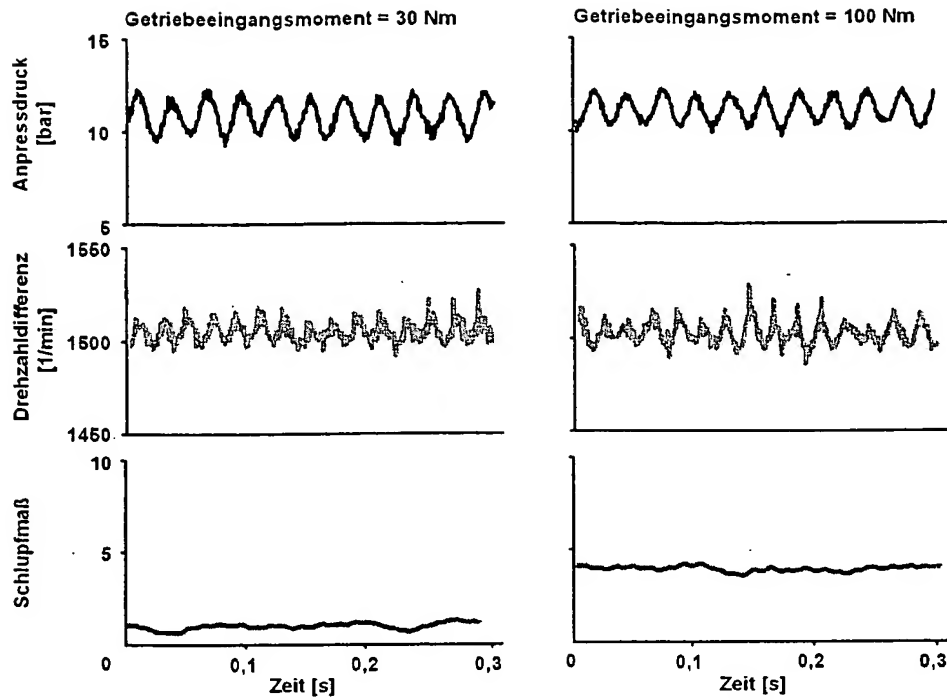
Figur 87



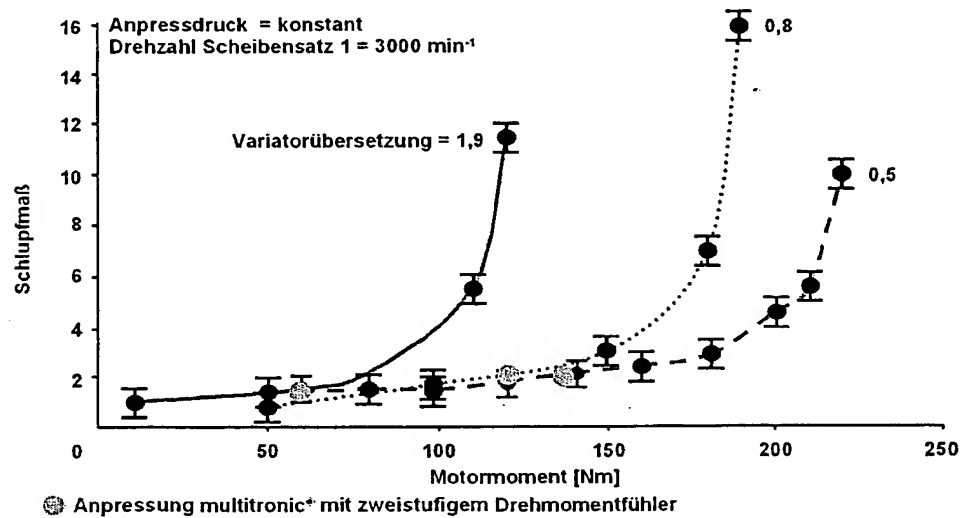
Figur 88



Figur 89

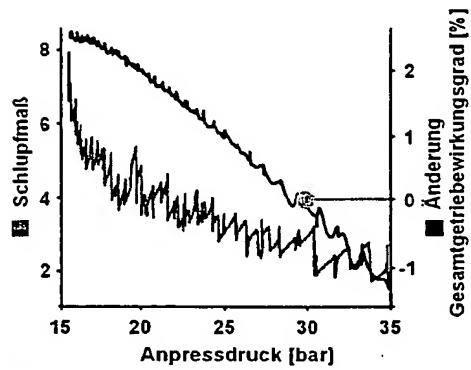


Figur 90



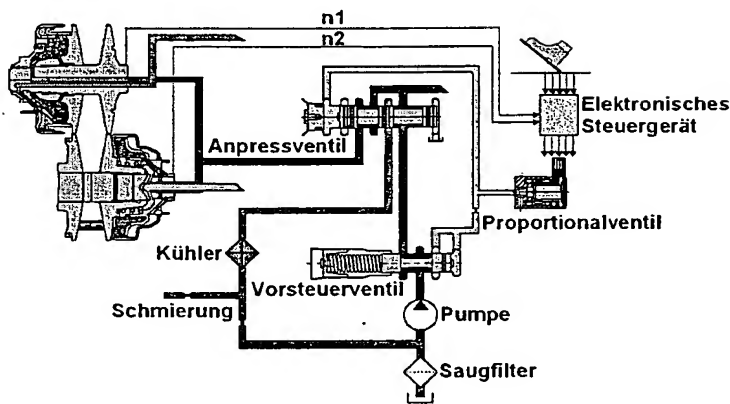
Figur 91

Variatorübersetzung = 0,47  
 Getriebeeingangsmoment = 310 Nm  
 Drehzahl Scheibensatz 1 = 2000 min<sup>-1</sup>

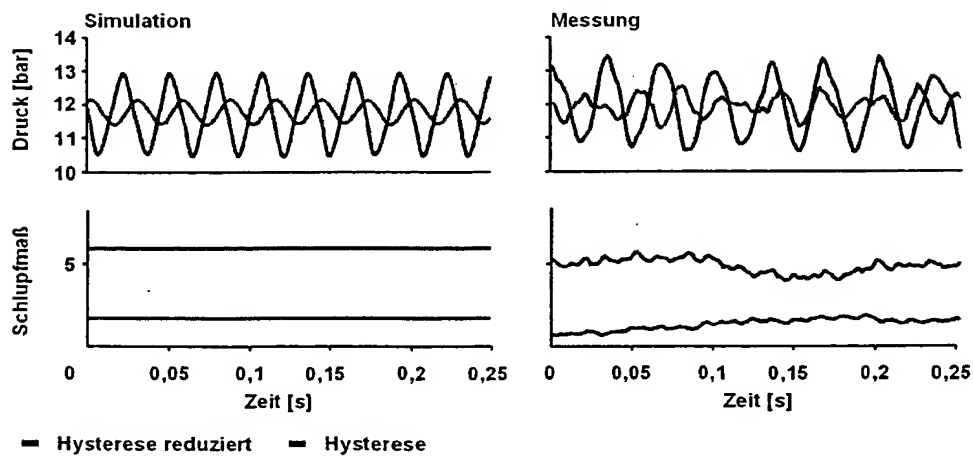


● Anpressung multitronic®  
 mit zweistufigem Drehmomentfühler

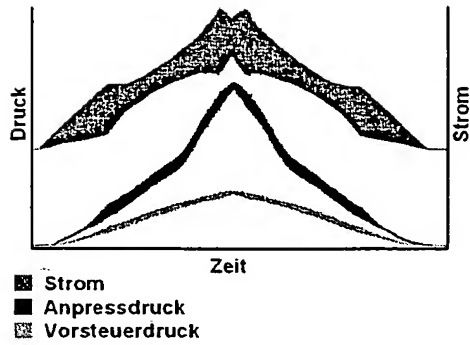
Figur 92



Figur 93

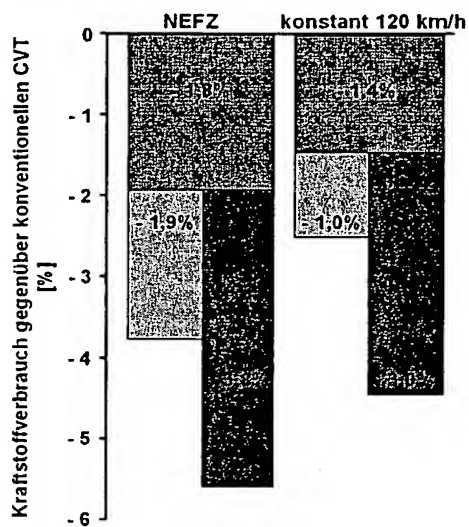


Figur 94



Figur 95

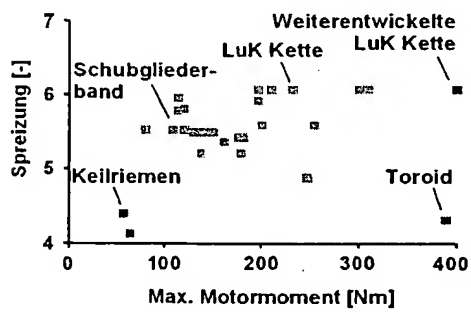
Motormoment = 300 Nm  
Motorleistung = 160 kW



LuK Doppelkolben  
kleinere Pumpe  
LuK Drehmomentfühler  
geringerer Anpressdruck  
LuK Weiterentwicklung  
Schlupfregelung und optimierte Hydraulik

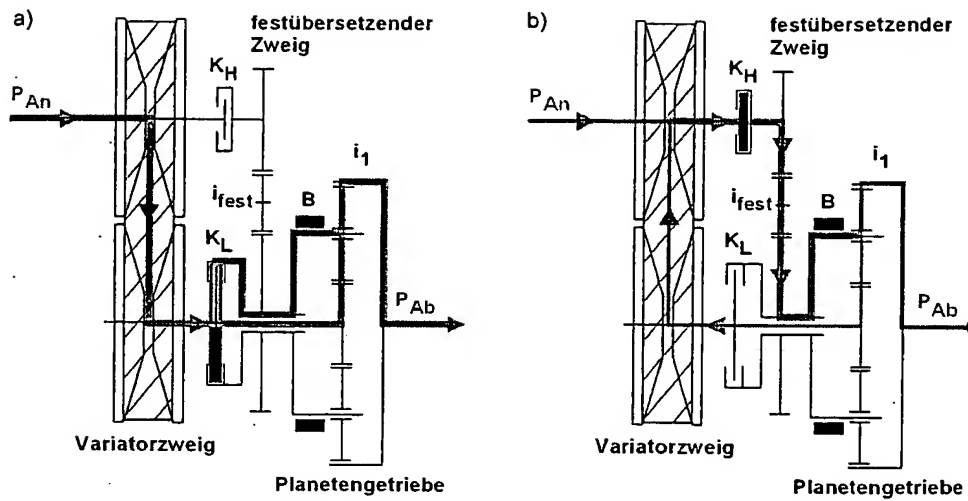
} multitronic<sup>®</sup>

Figur 96

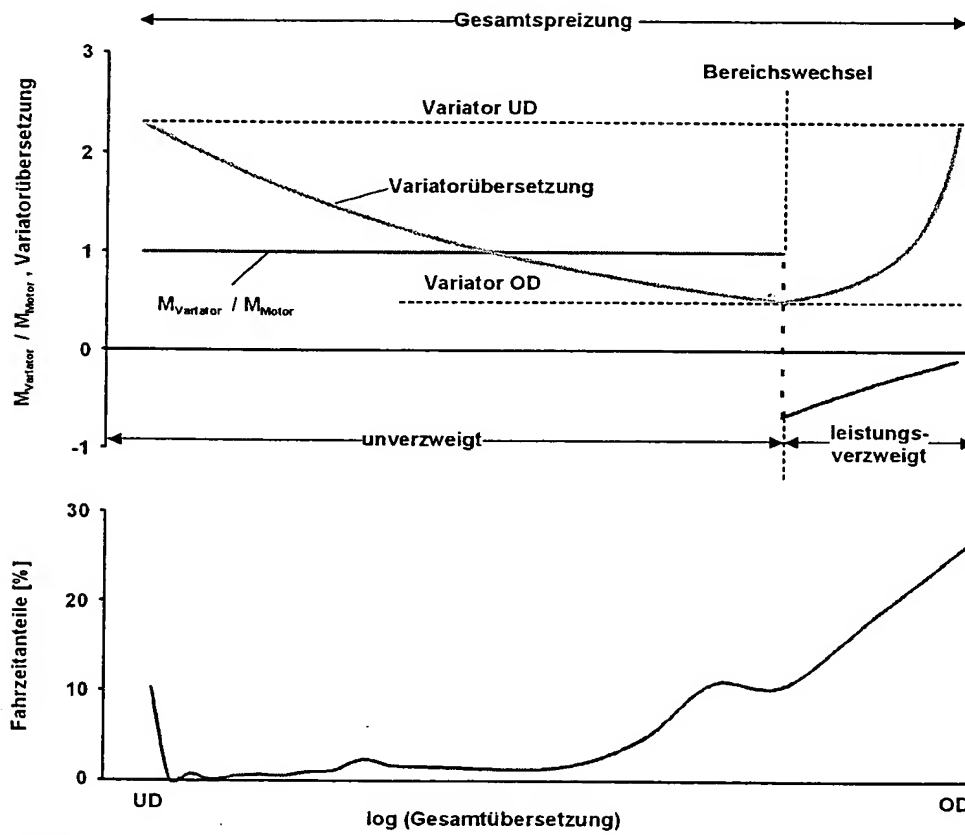


Figur 97

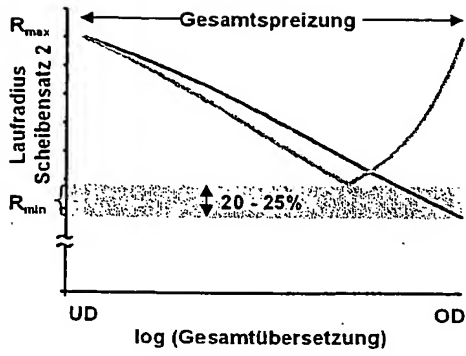




Figur 98

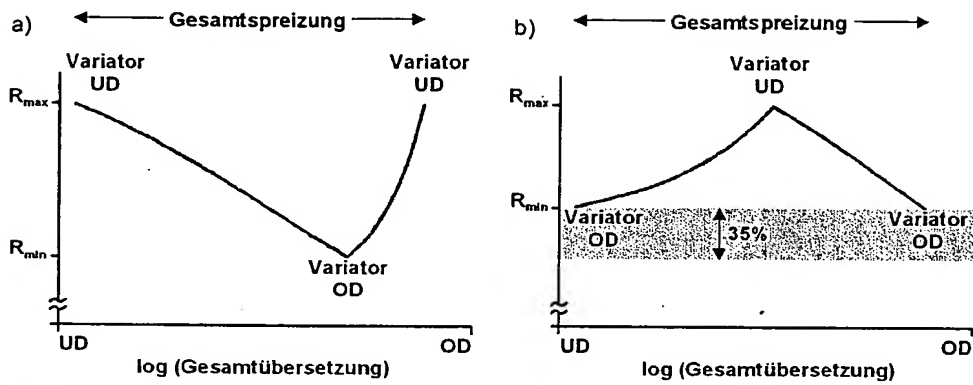


Figur 99

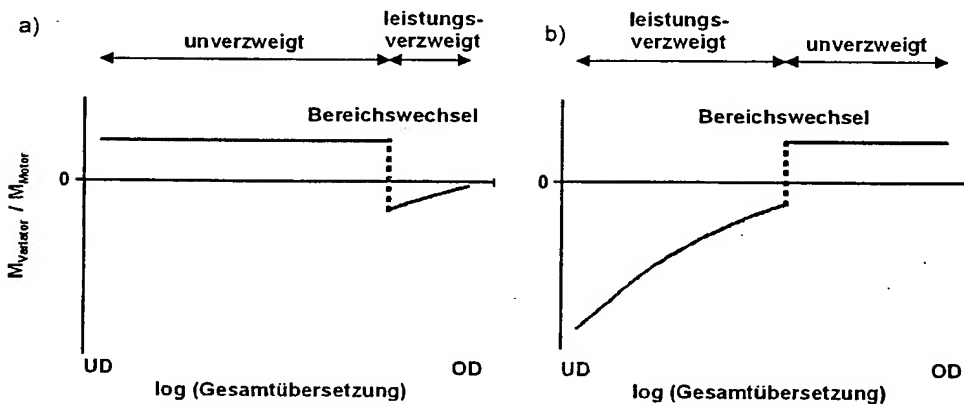


— unverzweigter Triebstrang  
 --- Zweibereich-CVT

Figur 100

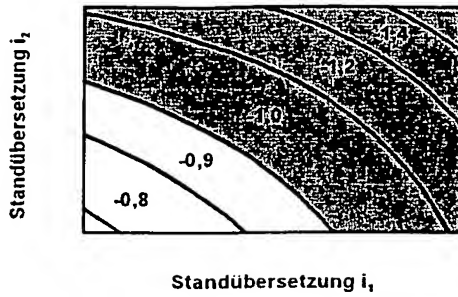


Figur 101

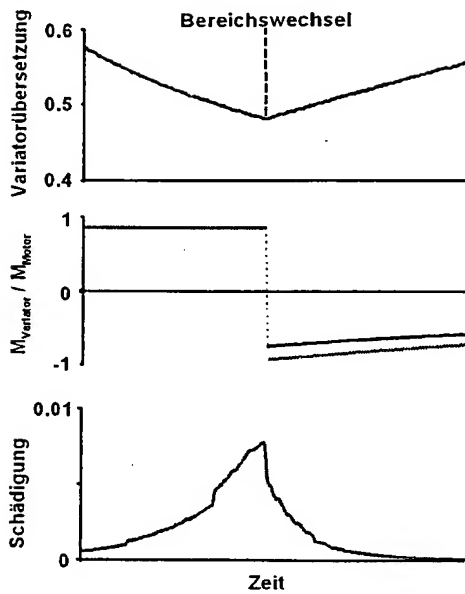


Figur 102

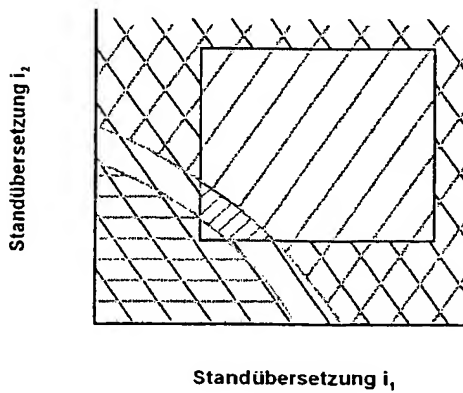
zu hohe Variatormomente am Bereichswechsel



Figur 103



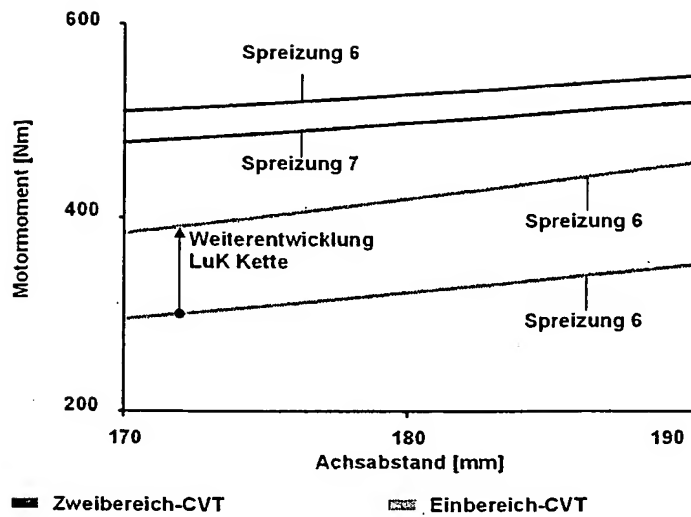
Figur 104



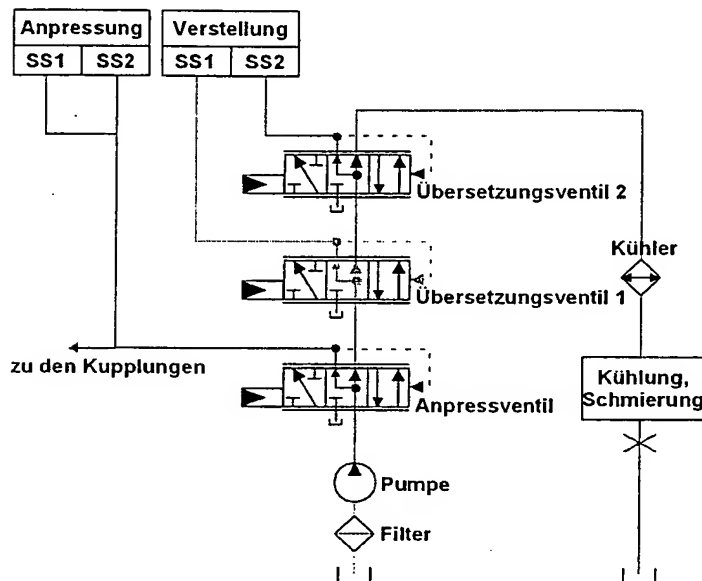
Ausschlusskriterien:

- ☒ R-Übersetzung, Variatormoment
- ☒ Bauraumbedingungen
- ☒ Spreizung

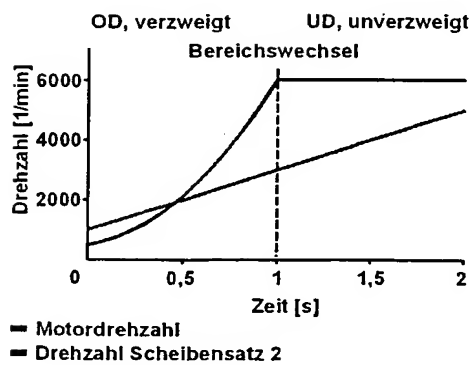
Figur 105



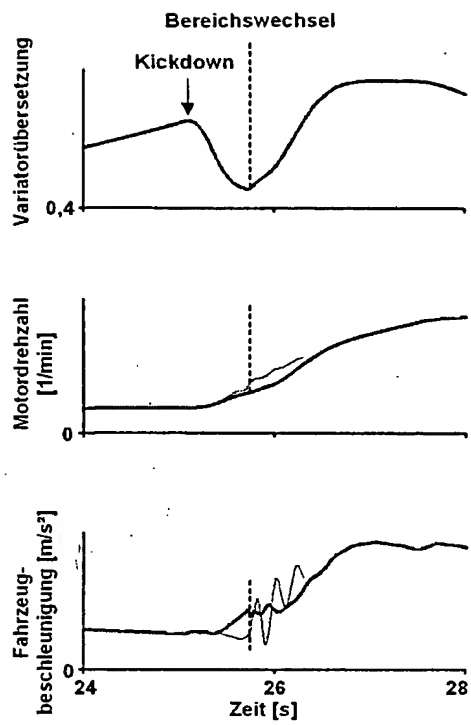
Figur 106



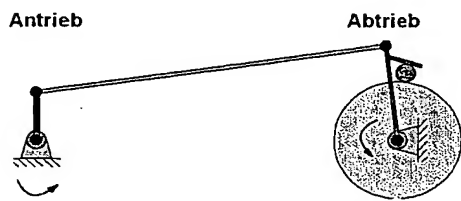
Figur 107



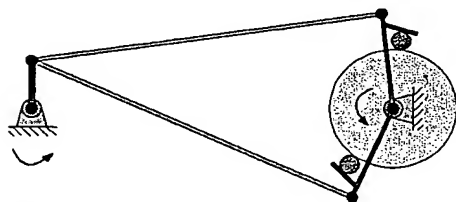
Figur 108



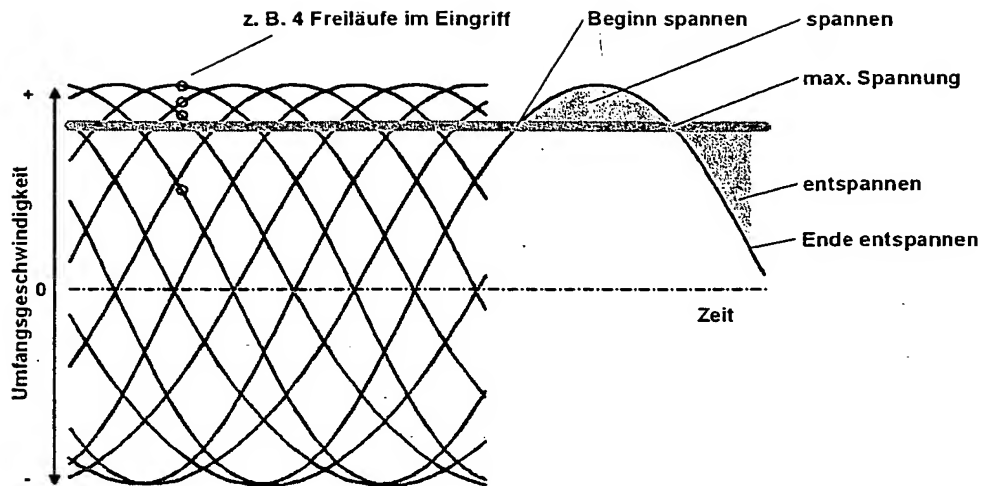
Figur 109



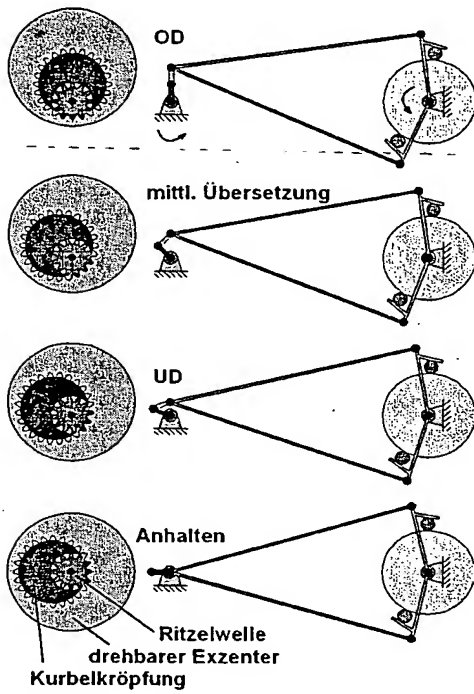
Figur 110



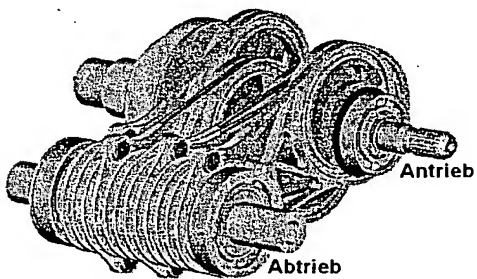
Figur 111



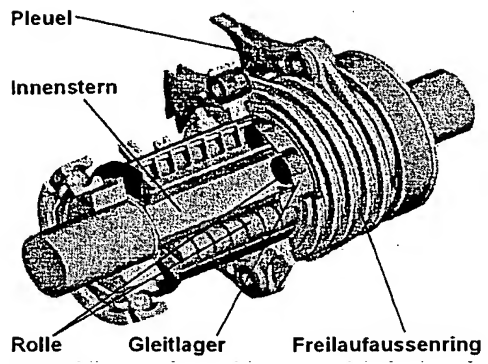
Figur 112



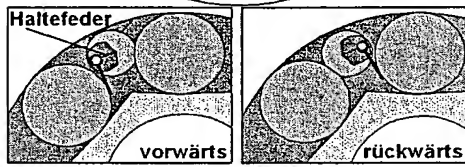
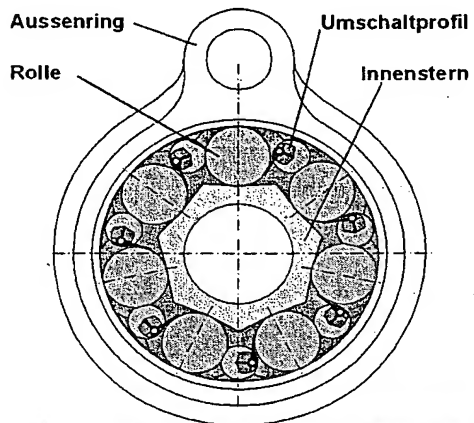
Figur 113



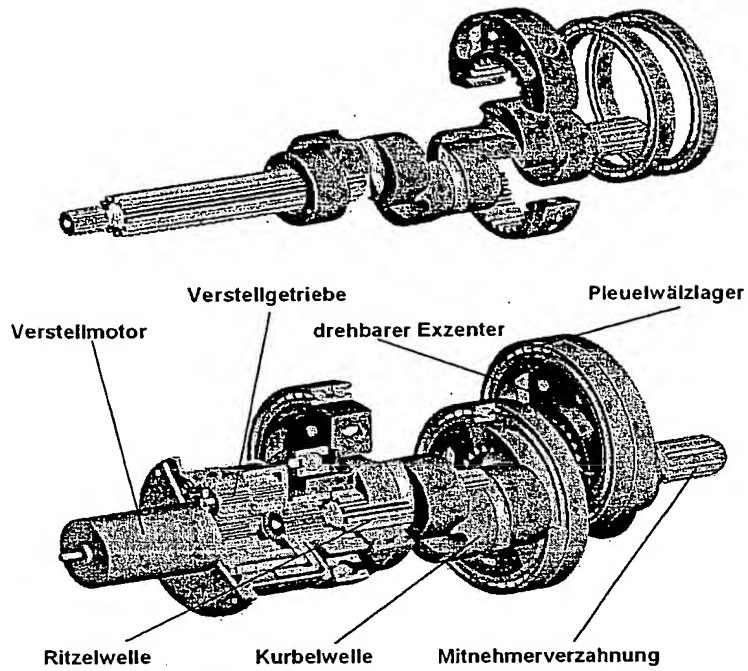
Figur 114



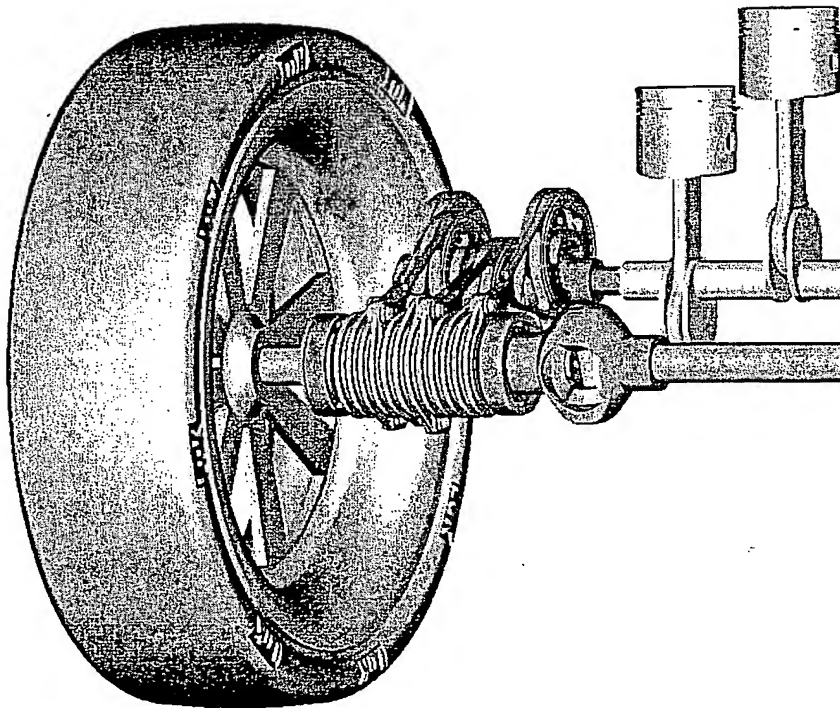
Figur 115



Figur 116

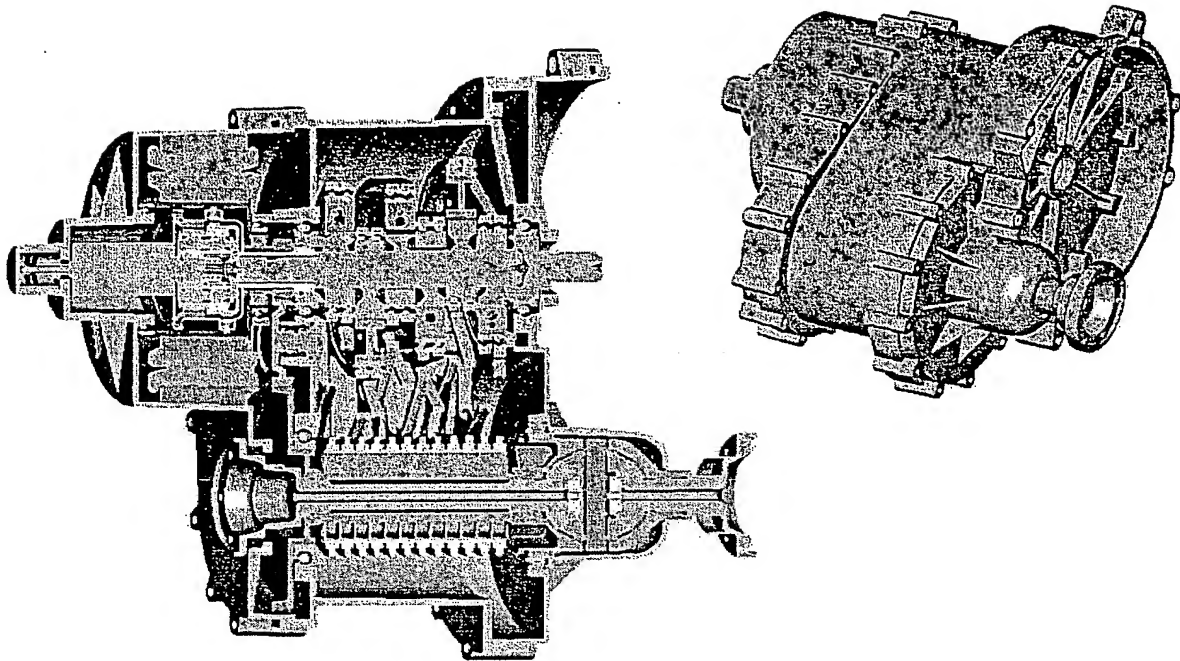


Figur 117

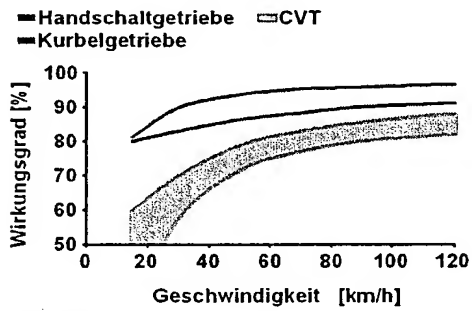


Figur 118

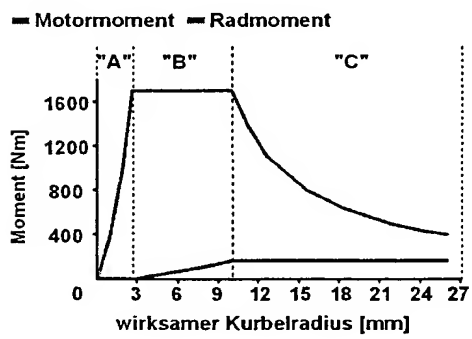




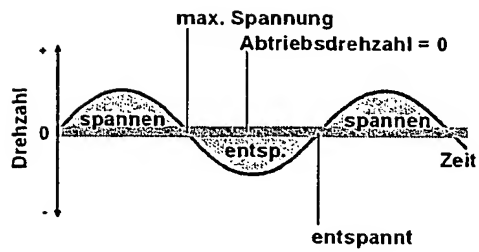
Figur 119



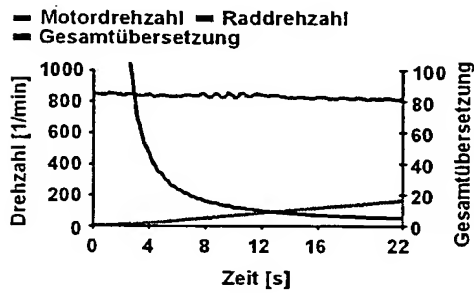
Figur 120



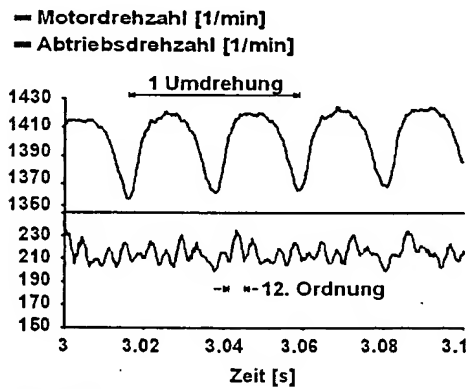
Figur 121



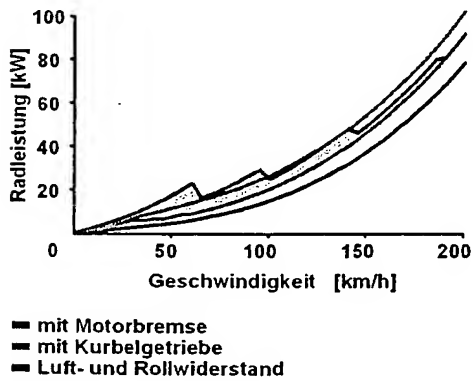
Figur 122



Figur 123



Figur 124



Figur 125

Servolenkung



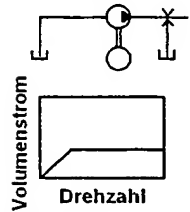
Antiwanksystem



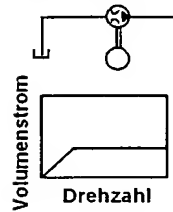
CVT Getriebe



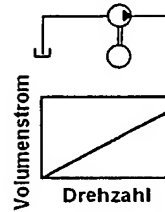
Hochdruckseitige  
Volumenstrom-  
regelung



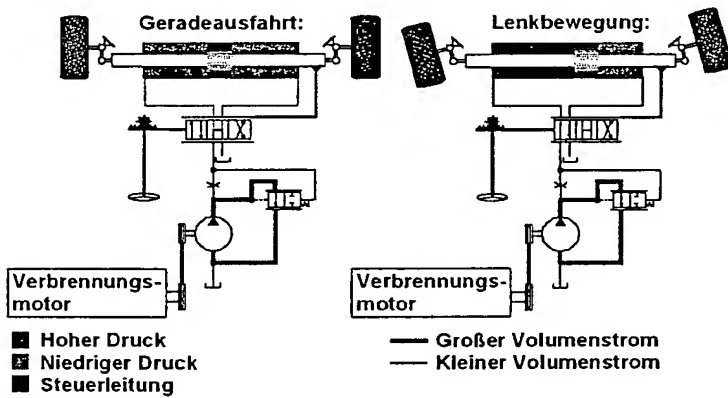
Saugseitige  
Volumenstrom-  
regelung



Verschiedene  
Konzepte

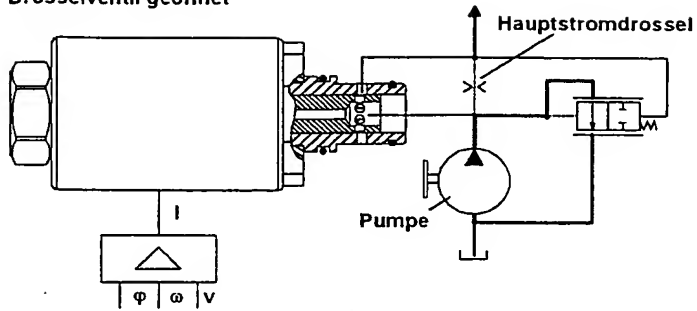


Figur 126

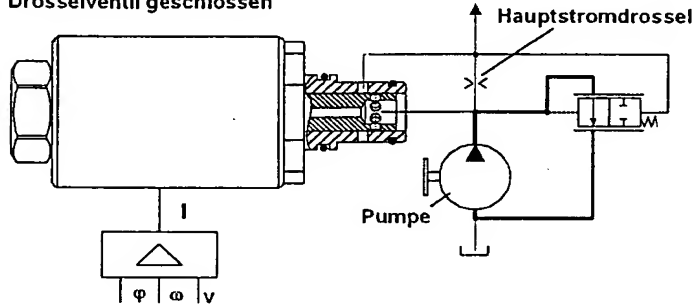


Figur 127

Drosselventil geöffnet



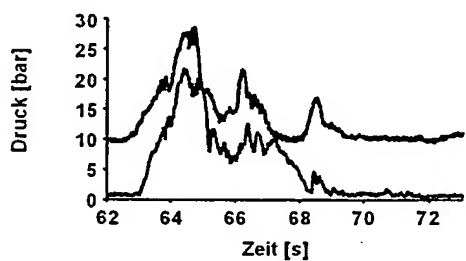
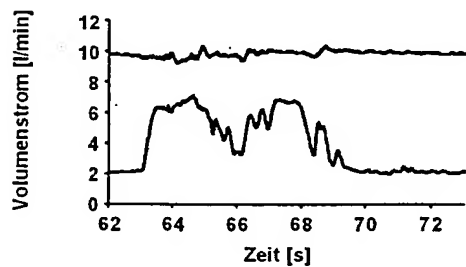
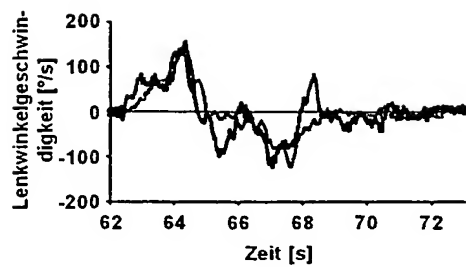
Drosselventil geschlossen



- Hoher Druck
- Niedriger Druck
- Steuerleitung

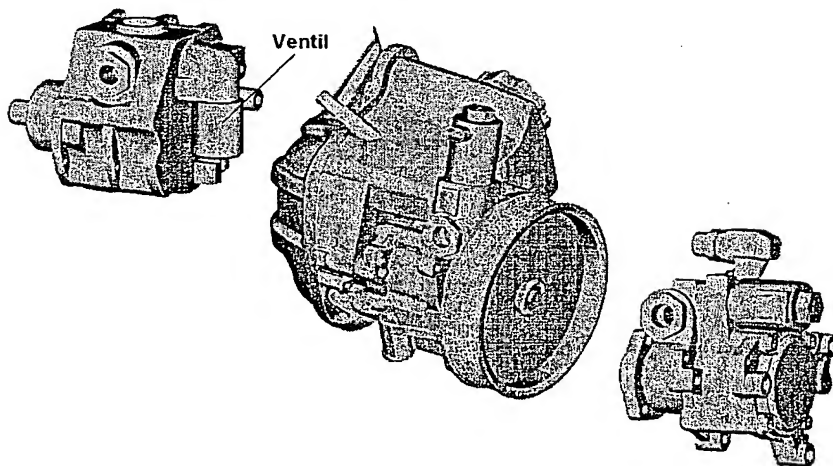
- Großer Volumenstrom
- Kleiner Volumenstrom

Figur 128



— Standardpumpe  
 - - - EV²

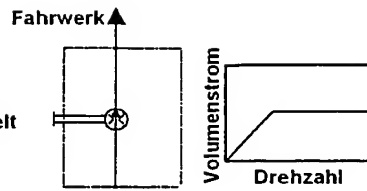
Figur 129



Figur 130

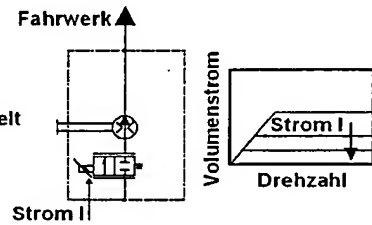
**Open Center  
Antiwanksystem**

Pumpe intern sauggedrosselt

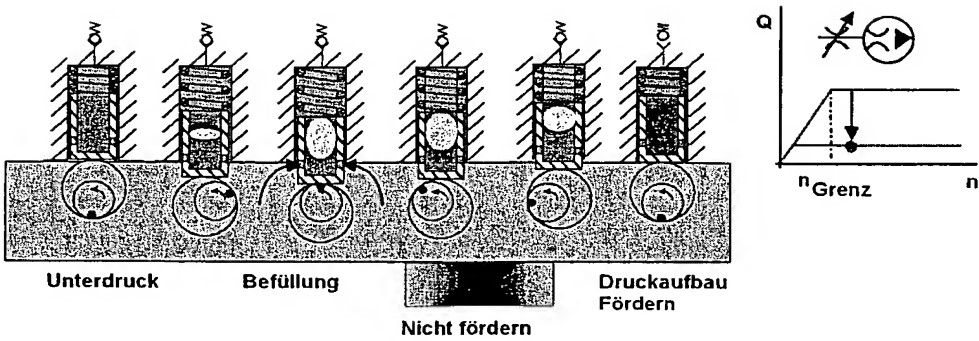
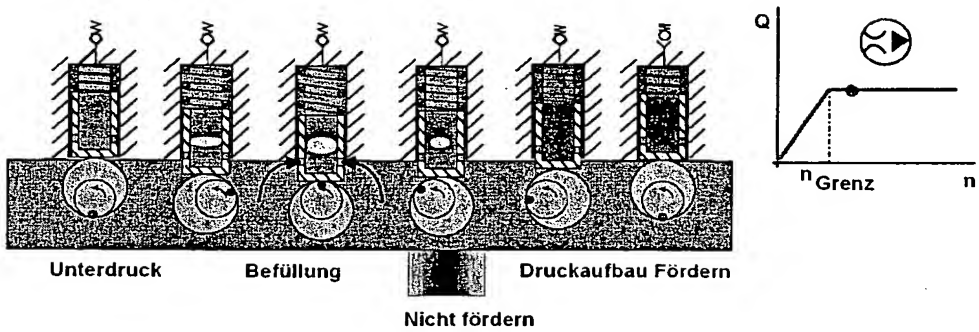
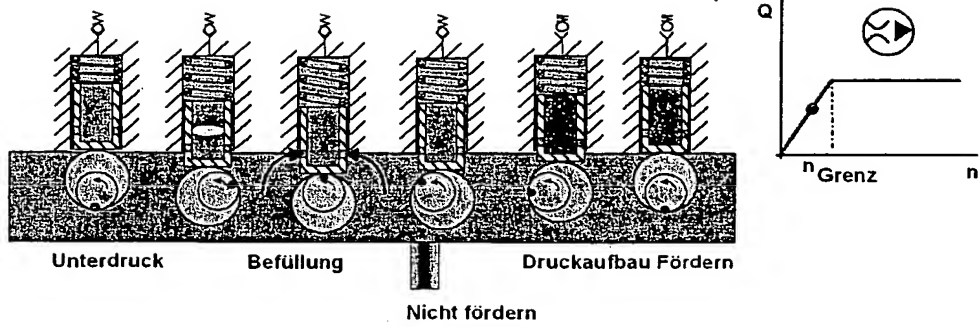


**Closed Center  
Antiwanksystem**

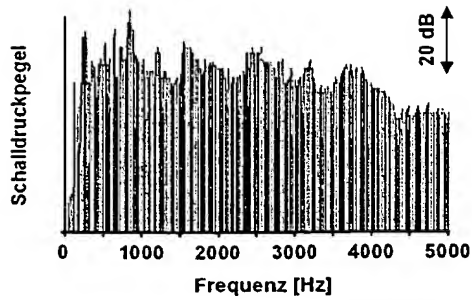
Pumpe intern sauggedrosselt  
und extern ansteuerbar  
sauggedrosselt



Figur 131



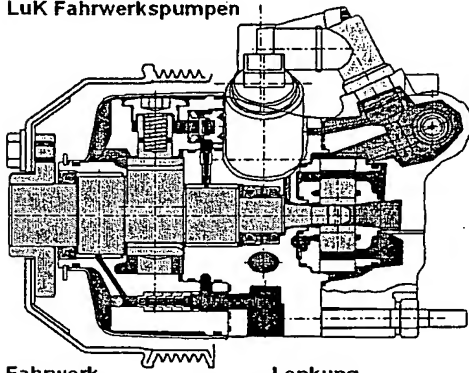
Figur 132



— Ausgangszustand  
 --- Optimiertes Design

Figur 133

#### LuK Fahrwerkspumpen



Fahrwerk

Lenkung

$V_{geo} = 6 - 6,7 \text{ cm}^3$

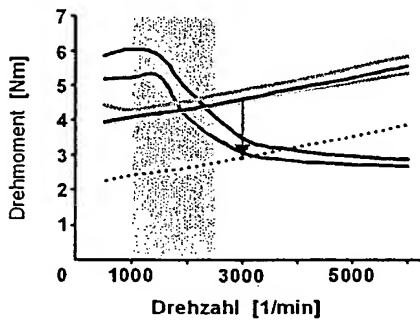
$p_{max} = 200 \text{ bar}$

$V_{geo} = 8,4 - 15 \text{ cm}^3$

$p_{max} = 135 \text{ bar}$

Figur 134

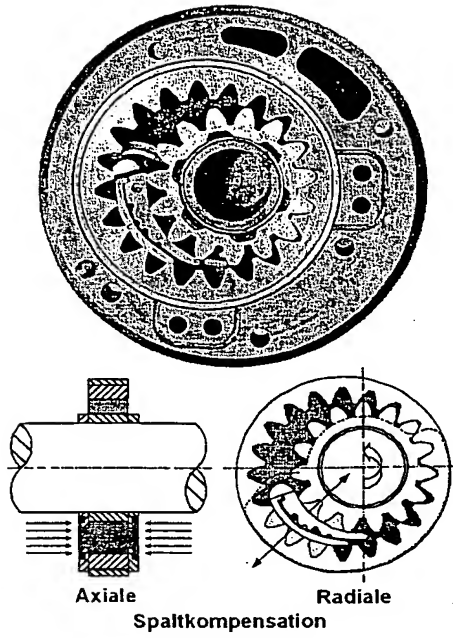
$n = 1000 \text{ min}^{-1}$ ,  $Q = 10,5 \text{ l/min}$ ,  $p = 20 \text{ bar}$ ,  
 $T = 90^\circ\text{C}$ ,  $Q_{max} \text{ erforderlich} = 15 \text{ l/min}$



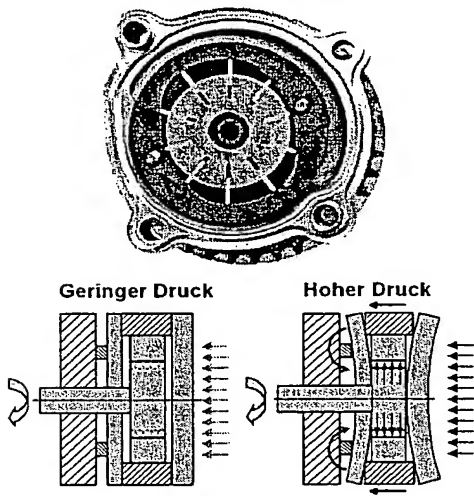
— Saugedrosselte Radialkolbenpumpe  
 --- Verstellbare Flügelzellenpumpe  
 ... Kompensierte Innenzahnradpumpe  
 -.- Konstant-Flügelzellenpumpe  
 — Zweiflutige FZP - zweiflutiger Betrieb 100%  
 ... Zweiflutige FZP - einflutiger Betrieb 50%

Figur 135

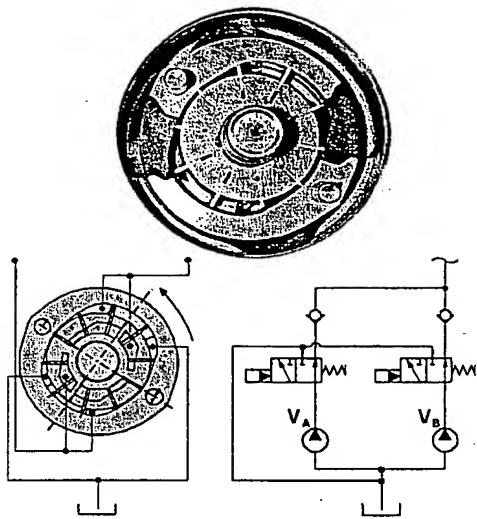




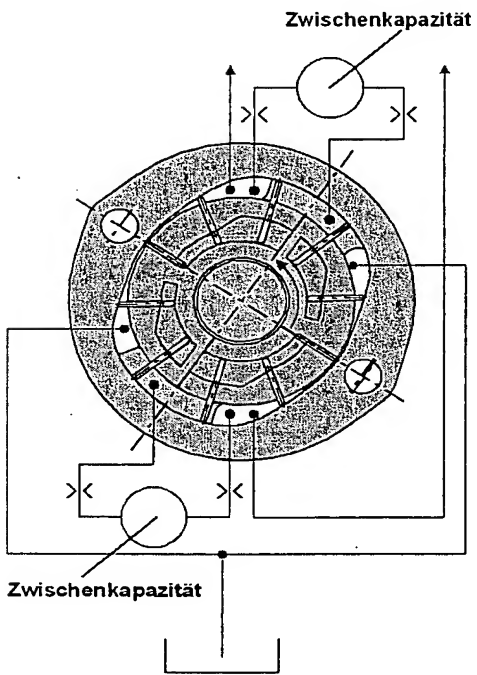
Figur 136



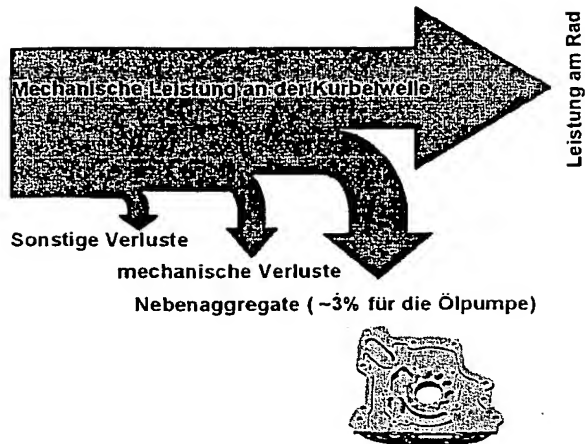
Figur 137



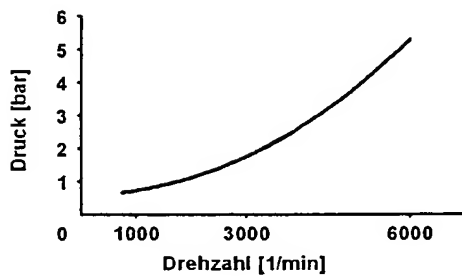
Figur 138



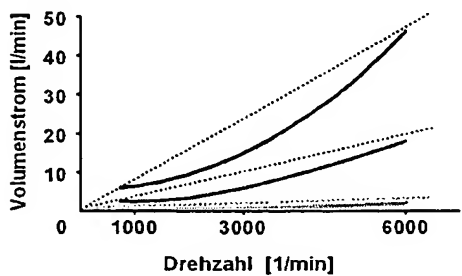
Figur 139



Figur 140

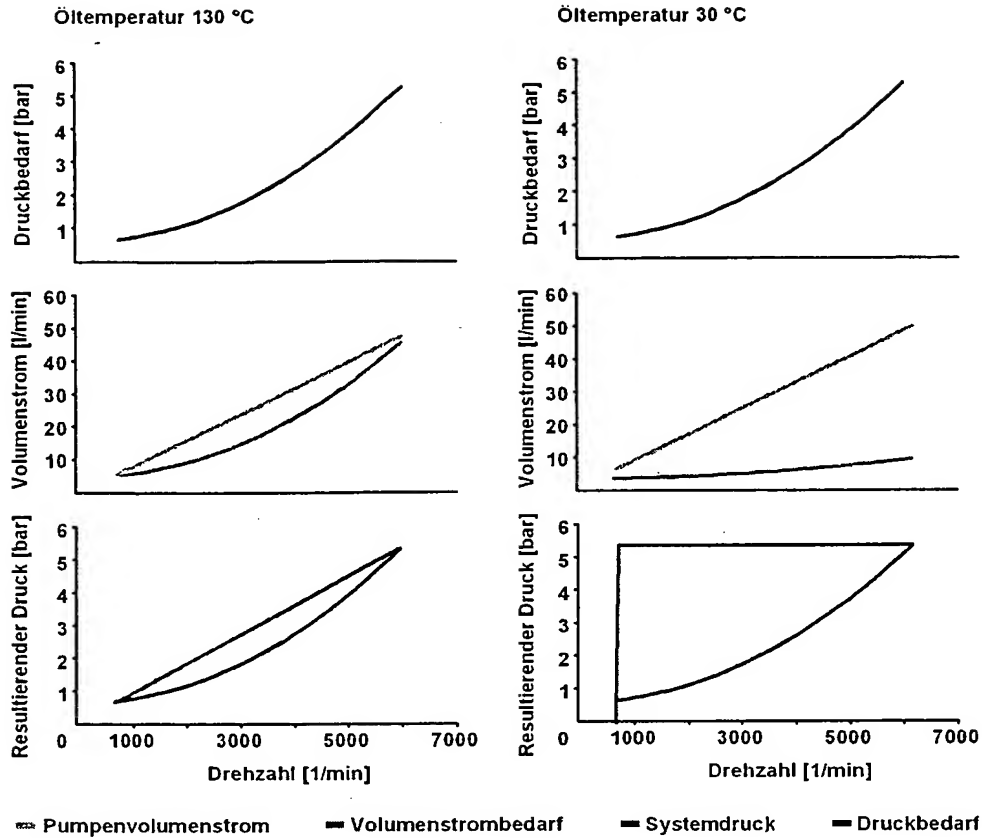


Figur 141

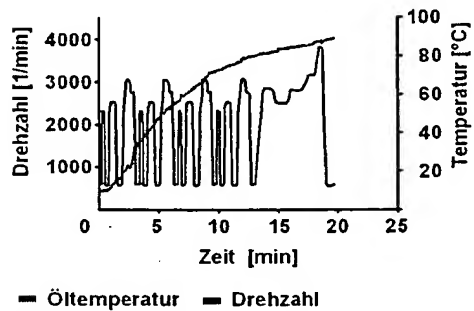


... Konstantpumpe    ■ Motorbedarf    130 °C  
 ... Konstantpumpe    ■ Motorbedarf    90 °C  
 ... Konstantpumpe    ■ Motorbedarf    30 °C

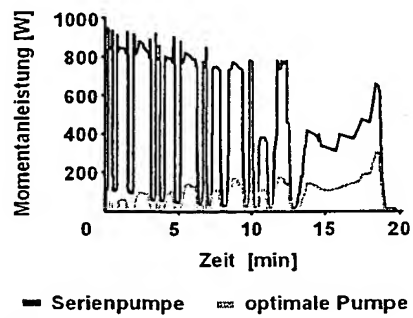
Figur 142



Figur 143



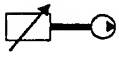
Figur 144



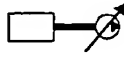
Figur 145

$$Q = V \cdot n$$

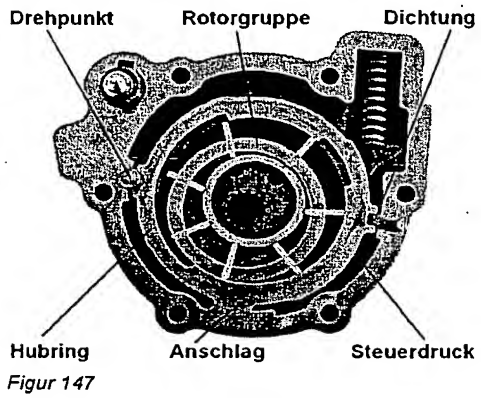
$$n = f(T)$$



$$V = f(T)$$

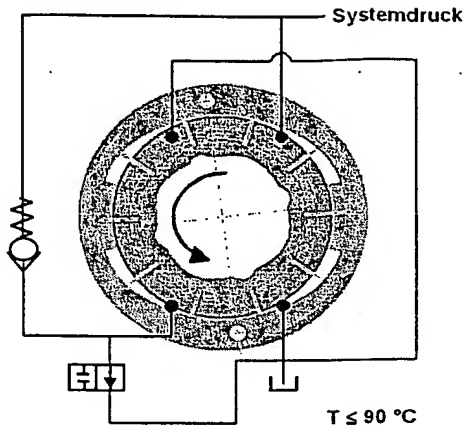


Figur 146

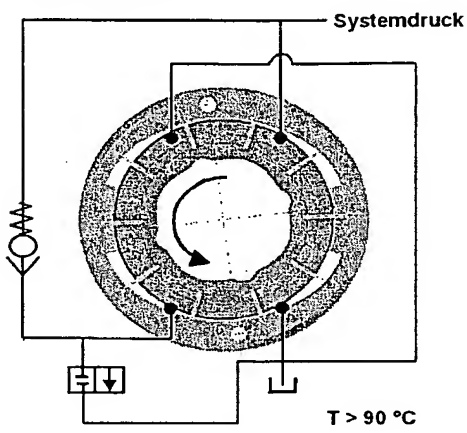


Figur 147

Schaltzustand 1

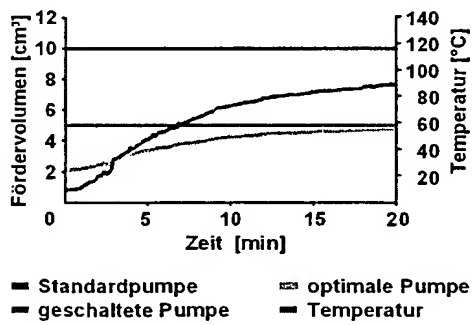


Schaltzustand 2

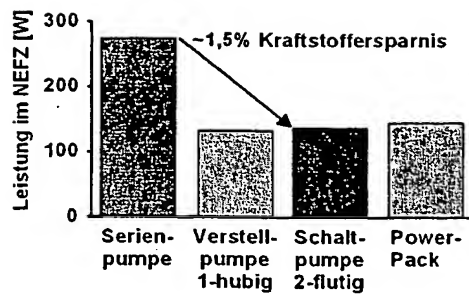


■ Niederdruck ■ Hochdruck

Figur 148



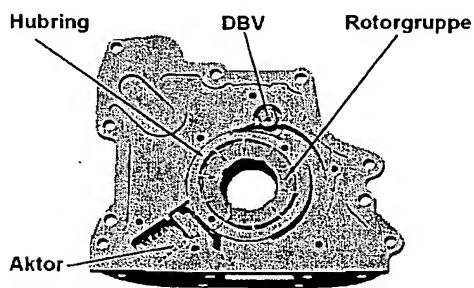
Figur 149



Figur 150

Lösungsprinzip	Variabler E-Motor	Variabler Hub	Schaltpumpe
Annäherung an den Druckbedarf			
Leistungsbedarf			
Betriebssicherheit			
Bauraum			
Kosten			

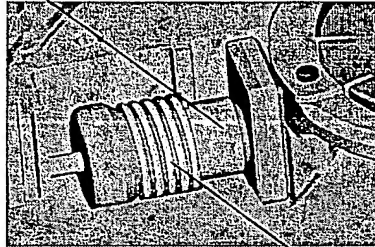
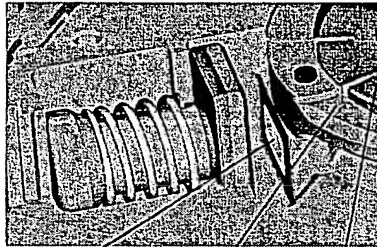
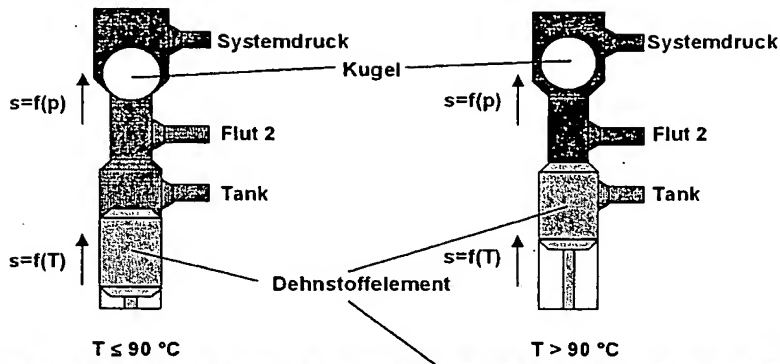
Figur 151



Figur 152

Schaltzustand 1

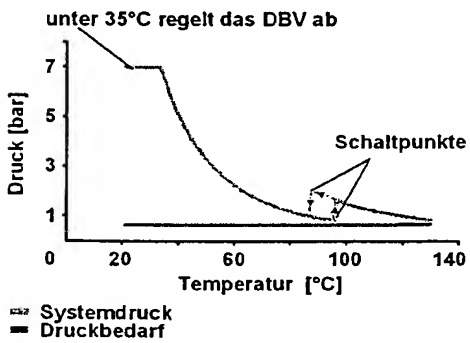
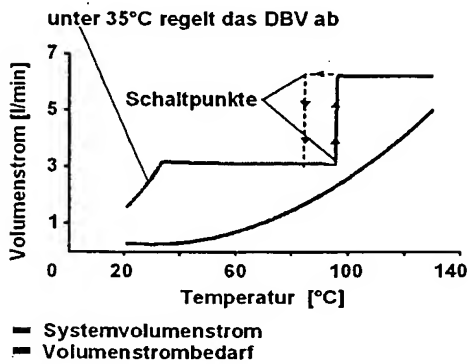
Schaltzustand 2



Auslasskanal Hubring Rotor

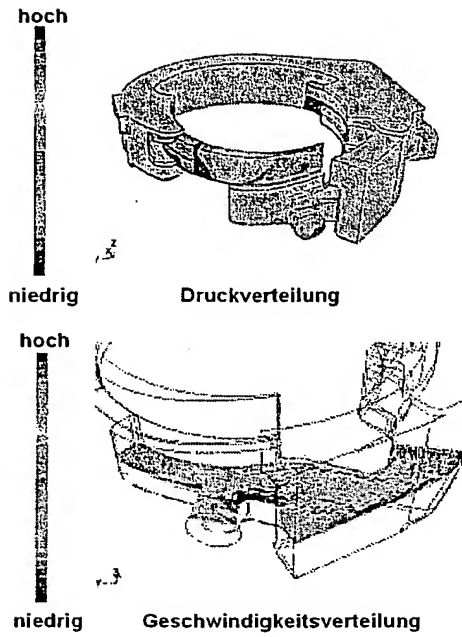
Rückholfeder

Figur 153



Figur 154

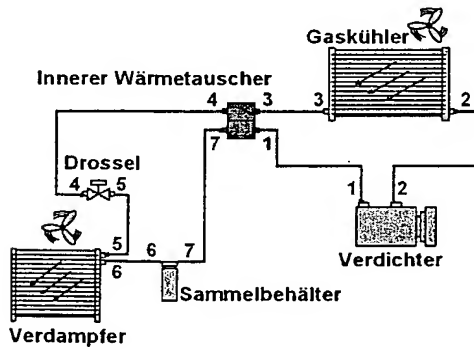




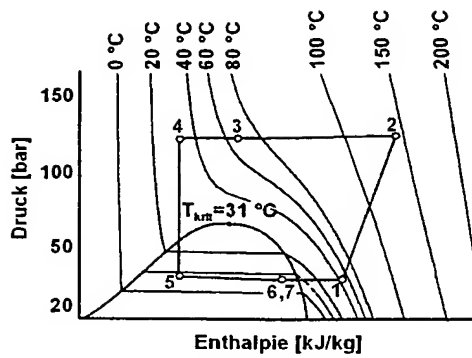
Figur 155

Name	HCFC (R12)	HFC (R134a)	CO <sub>2</sub> (R744)
Ozonschädigung	ja	ja	keine, da natürliches Gas
Treibhauspotenzial	GWP = 8100	GWP = 1300	GWP = 1
CO <sub>2</sub> Ausstoß durch Betrieb	2600 kg / PKW	2600 kg / PKW	1800 kg / PKW
CO <sub>2</sub> GWP-Äquivalent über Lebensdauer	8100 kg / PKW	1300 kg / PKW	0,5 kg / PKW
Summe	10700 kg / PKW	3900 kg / PKW	1800,5 kg / PKW













Figur 156



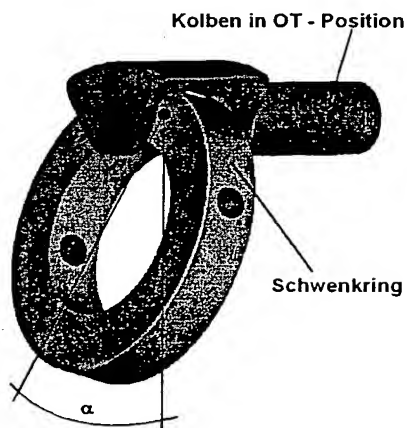
Figur 157



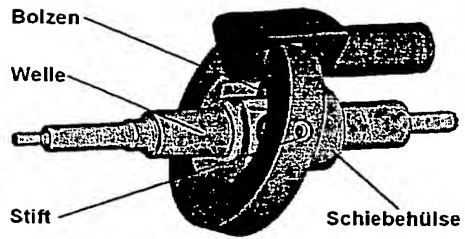
Figur 158

Bauart	Flügelzellenverdichter	Spiralverdichter	Axialkolbenverdichter
Massenstrom-regelung	Bypass	Bypass	Hubverstellung über Schwenkmechanismus
Wirkungsgrad der Klimaanlage, Verdichter mit max. Massenstrom (COP)	 (2)	 (2)	 (2)
Wirkungsgrad der Klimaanlage, Verdichter mit abgeregeltem Massenstrom (COP)	 (1)	 (1)	 (1,8)
Geräusch	 (2)	 (2)	 (2)
Kosten	 (2)	 (2)	 (2)

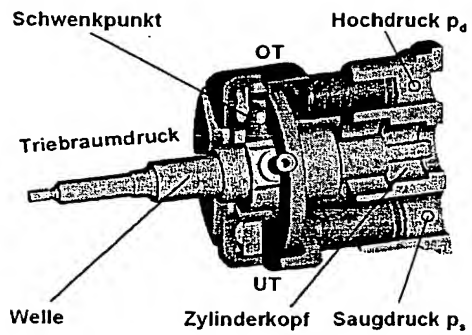
Figur 159



Figur 160

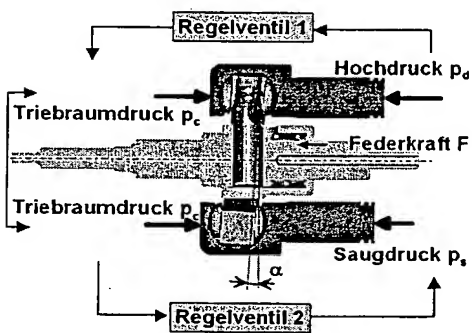


Figur 161



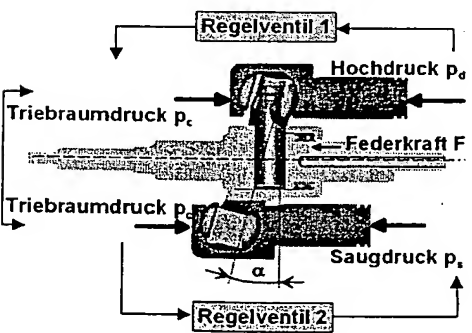
Figur 162

Schwenkwinkel  $\alpha$  bei  $p_c > p_s$



Figur 163

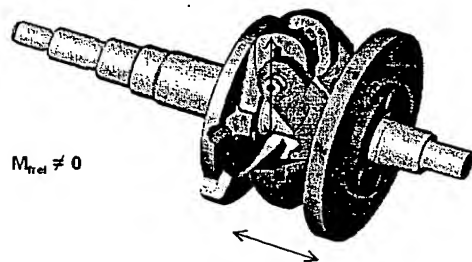
Schwenkwinkel  $\alpha$  bei  $p_c = p_s$



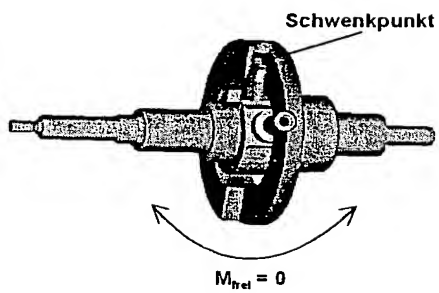
Figur 164

Schwenk- mechanismus	Maximal- drehzahl	Regelbarkeit bei CO <sub>2</sub>	Geräusch
Taumelscheibe			
Schwenkscheibe			
Schwenkring			

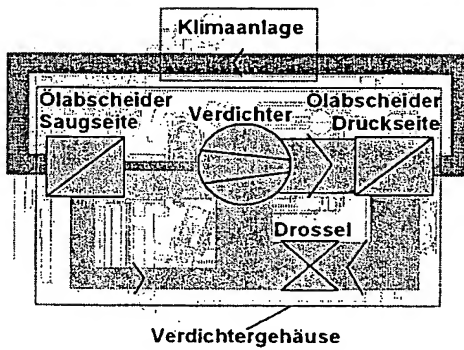
Figur 165



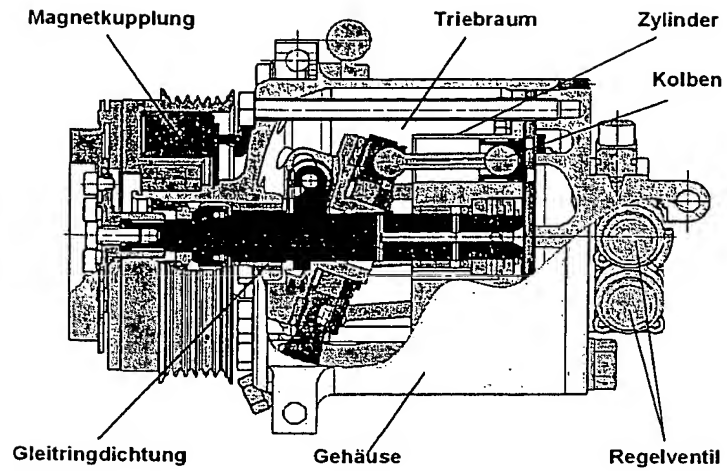
Figur 166



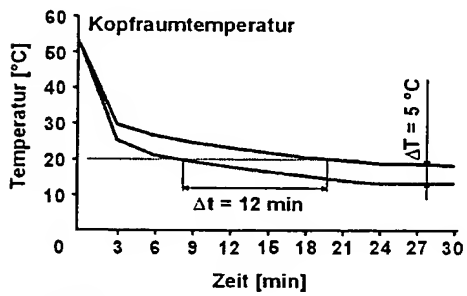
Figur 167



Figur 168

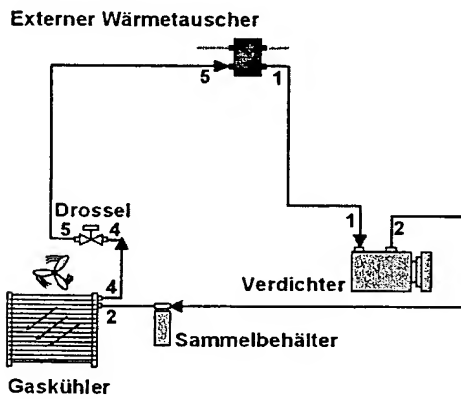


Figur 169

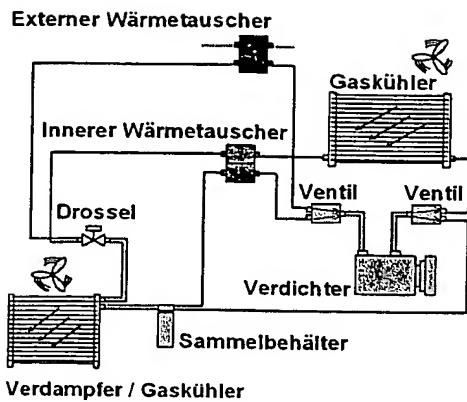


— R134 a  
 - - - CO<sub>2</sub>

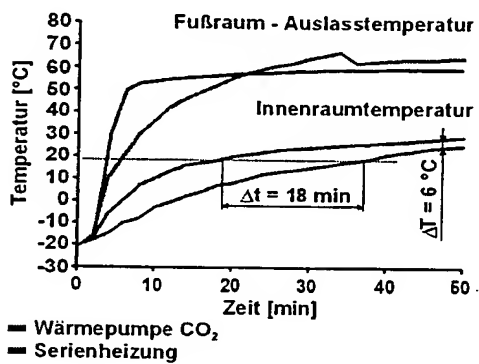
Figur 170



Figur 171



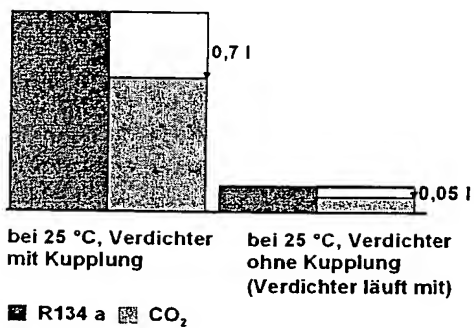
Figur 172



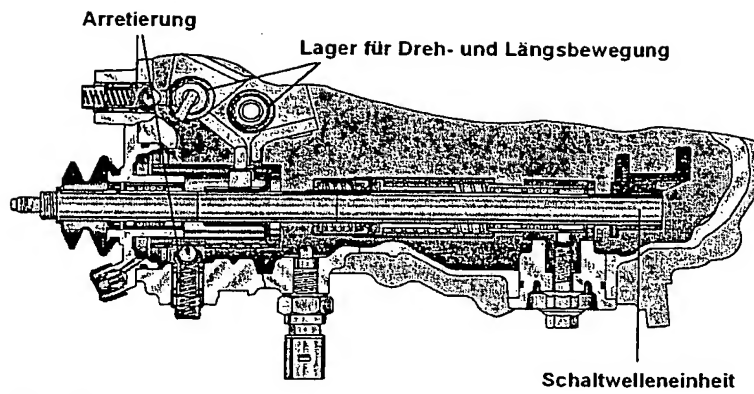
Figur 173

Klimaanlage "an"

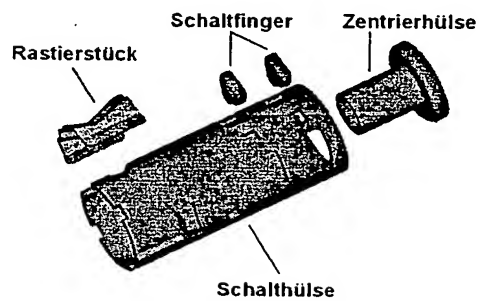
Klimaanlage "aus"



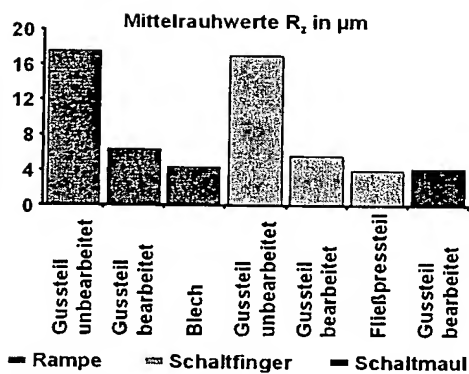
Figur 174



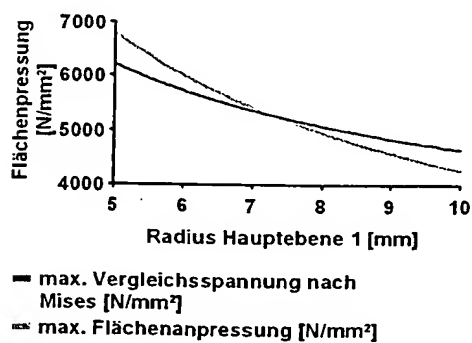
Figur 175



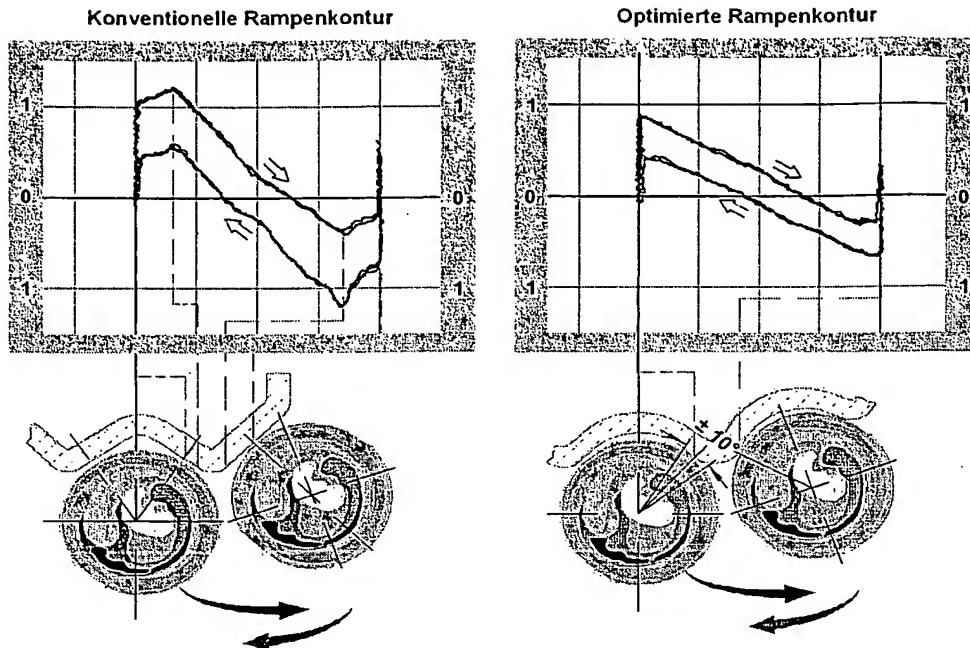
Figur 176



Figur 177

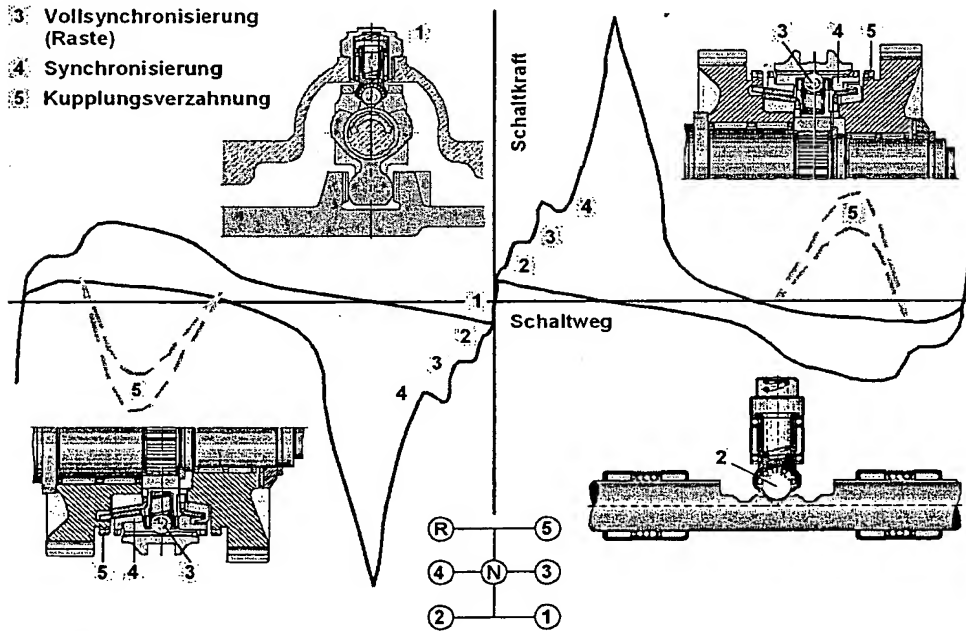


Figur 178



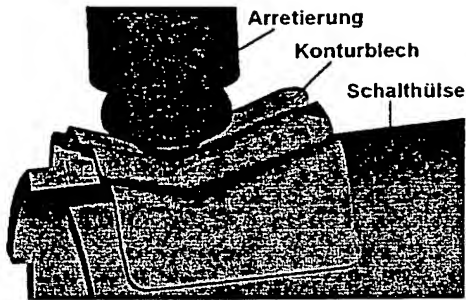
Figur 179

- 1 Neutralrastierung
- 2 Stangenrastierung
- 3 Vollsynchronisierung (Raste)
- 4 Synchronisierung
- 5 Kupplungsverzahnung

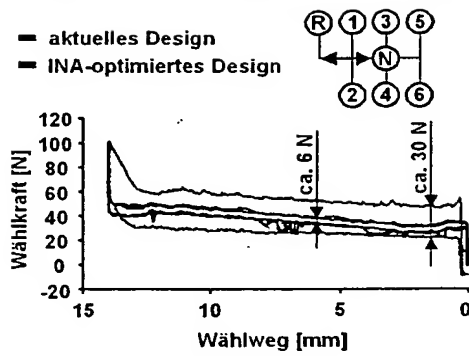


Figur 180

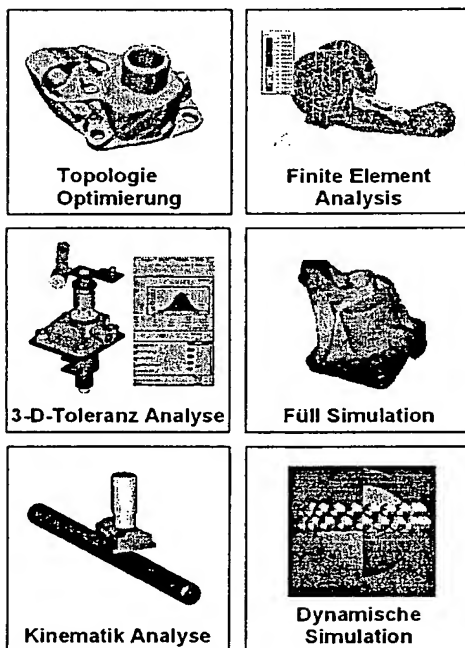




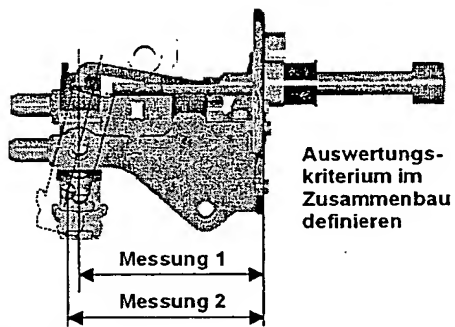
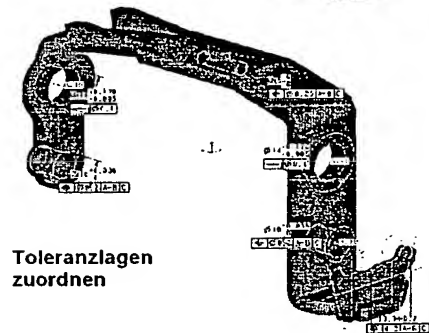
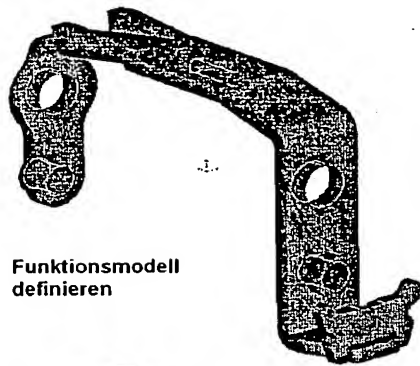
Figur 181



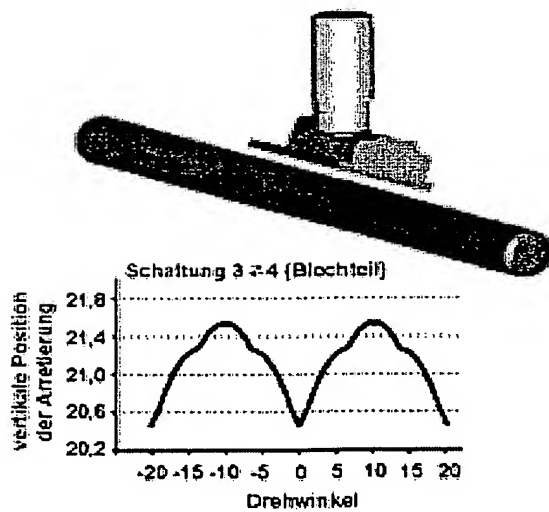
Figur 182



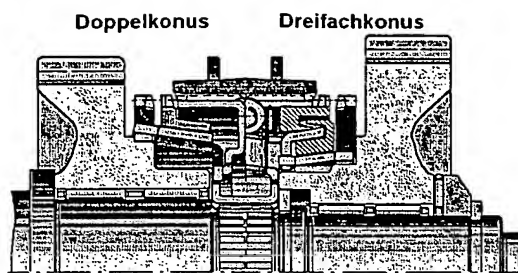
Figur 183



Figur 184

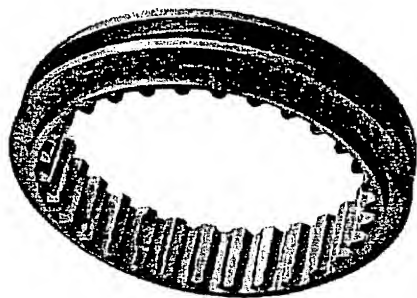


Figur 185

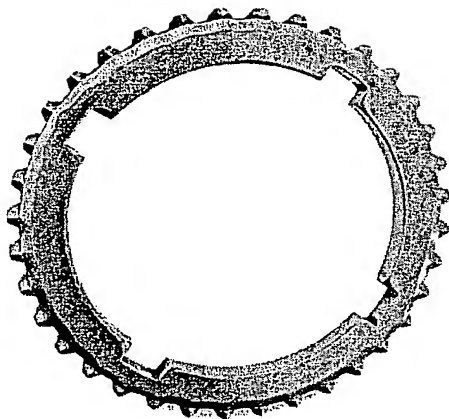


Figur 186

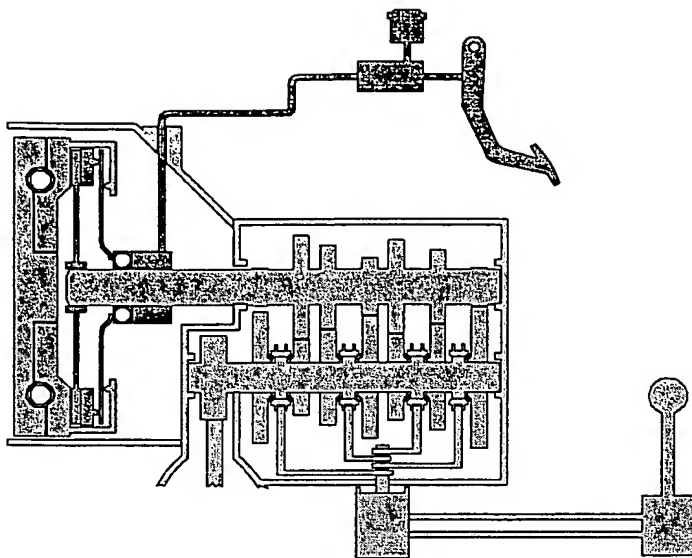
- Vorsynchronisation
- Außensynchronisation
- Zwischenring
- Innensynchronisation
- Kupplungsverzahnungsscheibe
- Radkonusring
- Schiebemuffe
- Synchronkörper



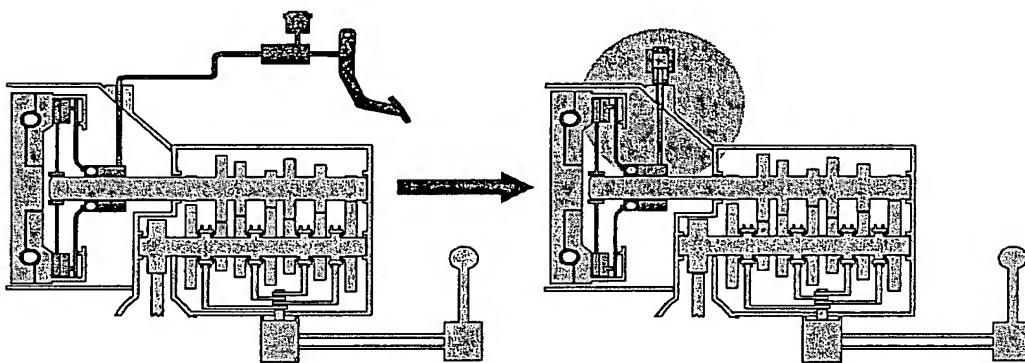
Figur 187



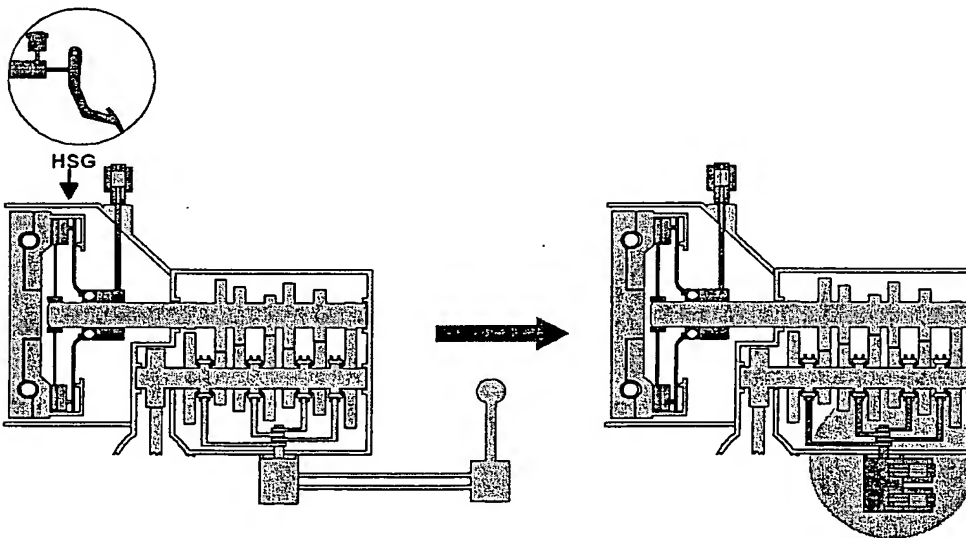
Figur 188



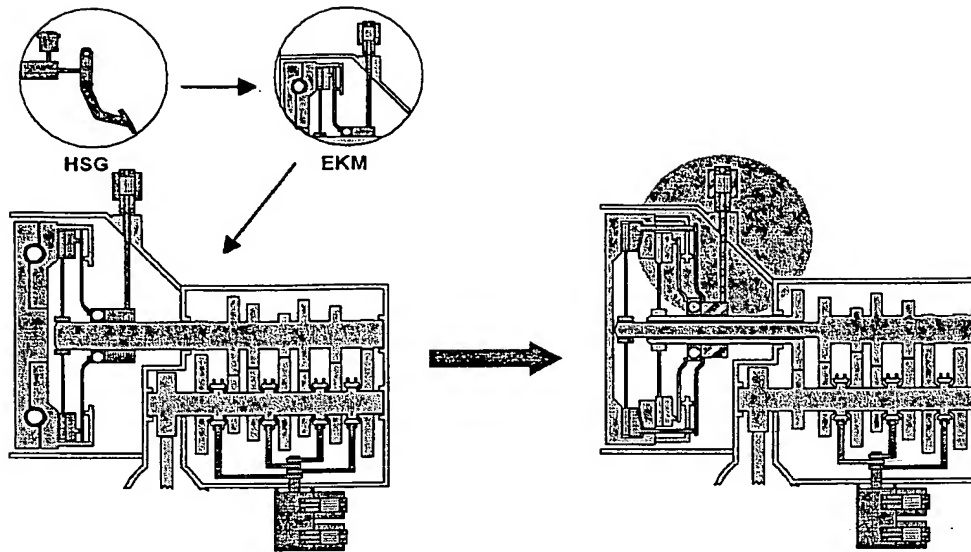
Figur 189



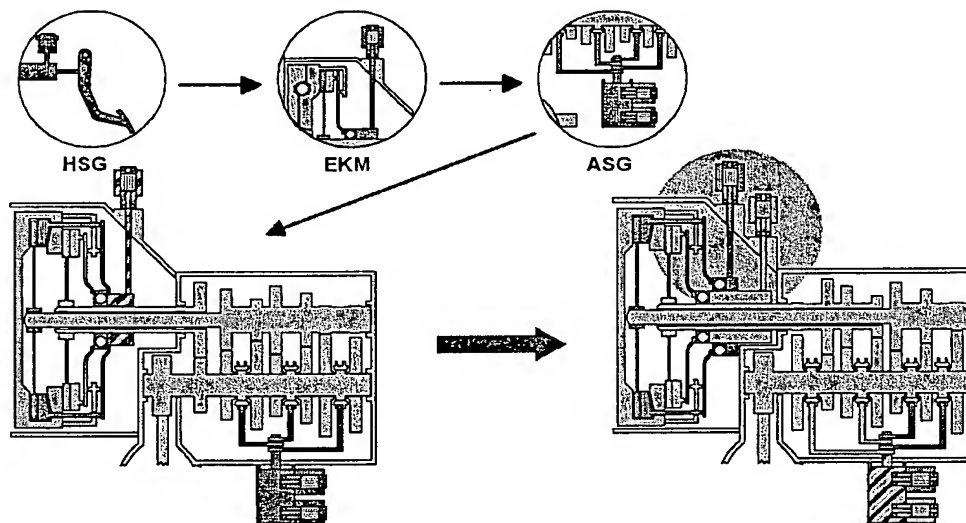
Figur 190



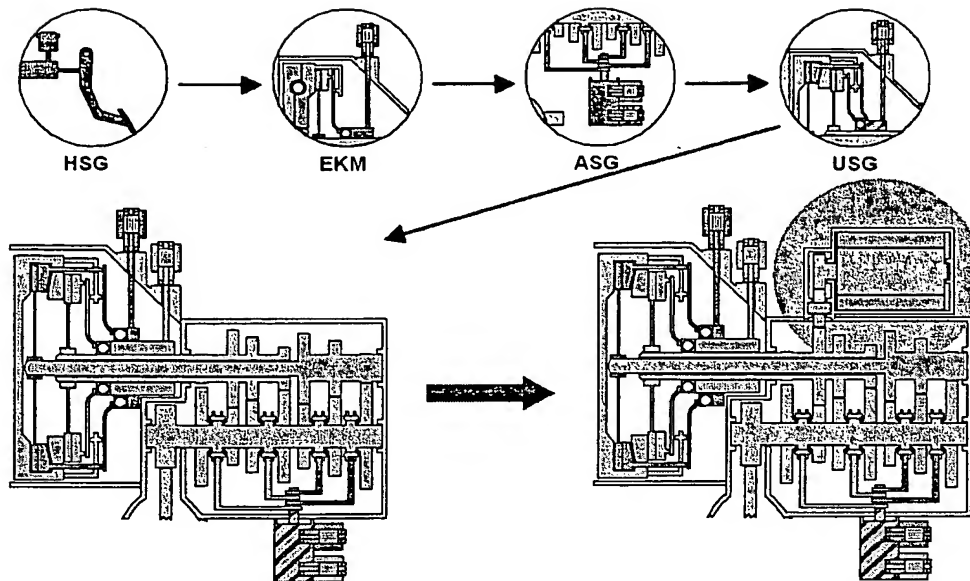
Figur 191



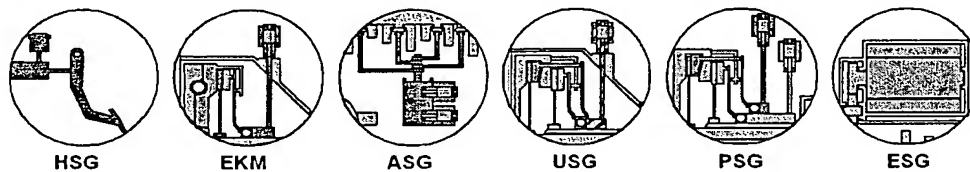
Figur 192



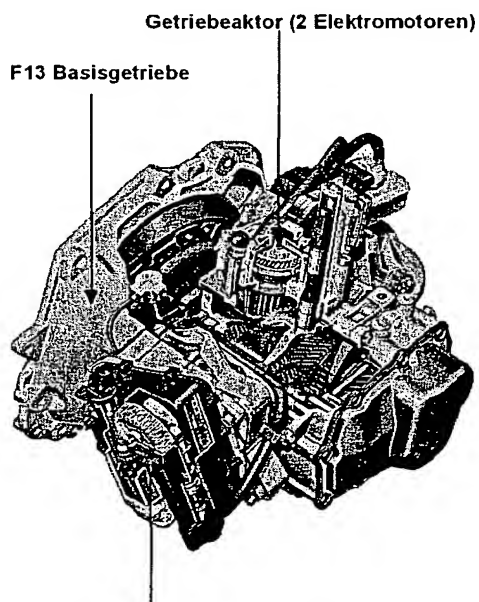
Figur 193



Figur 194

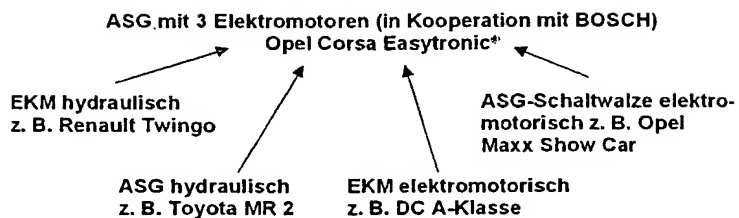
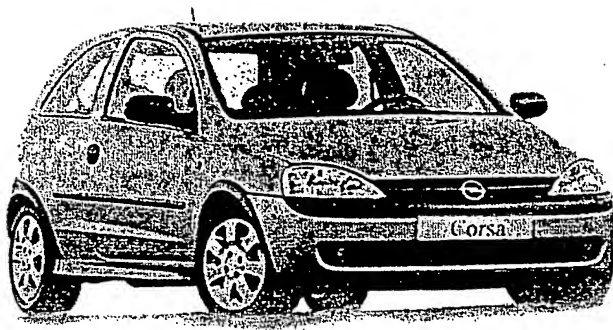


Figur 195

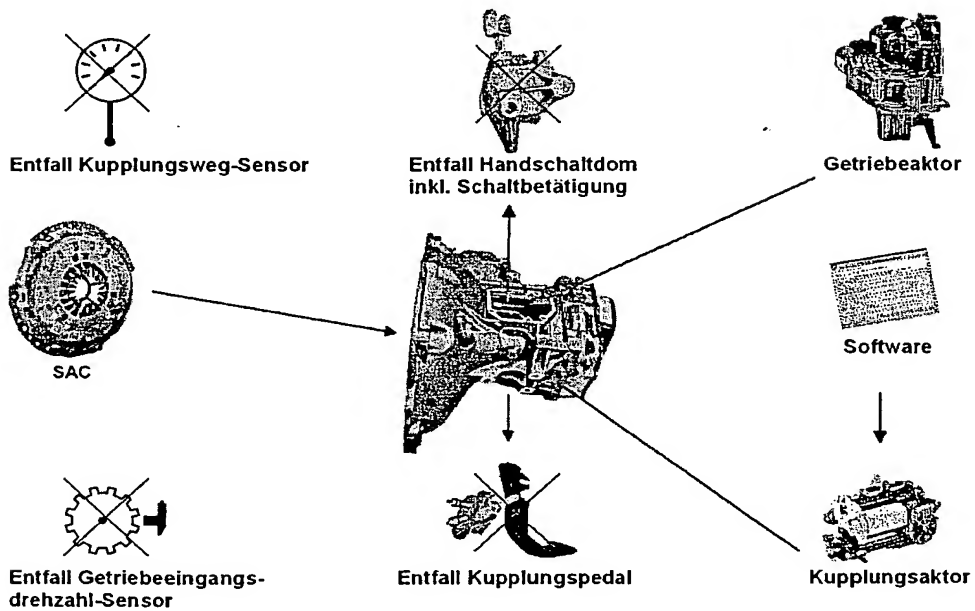


Kupplungsaktor und Steuergerät

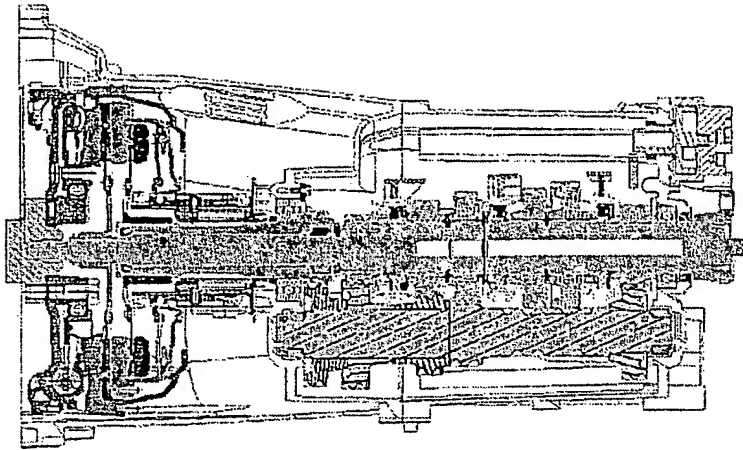
Figur 196



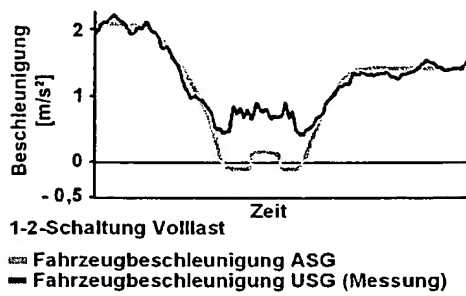
Figur 197



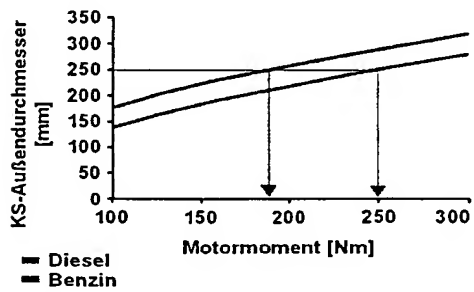
Figur 198



Figur 199

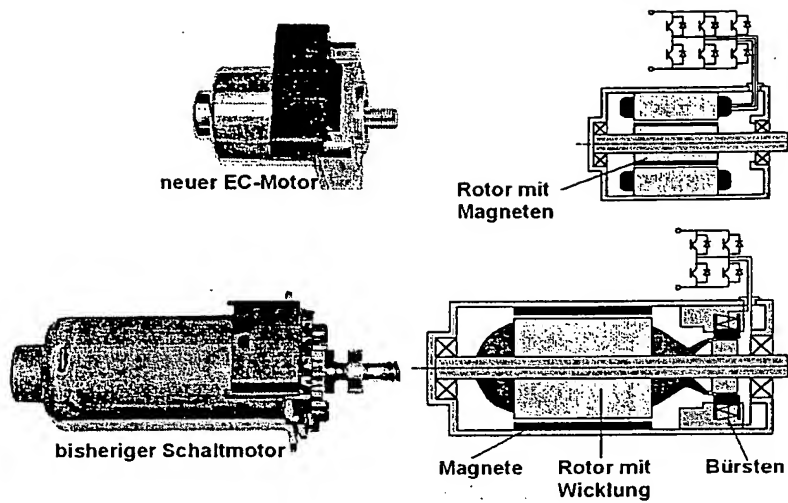


Figur 200

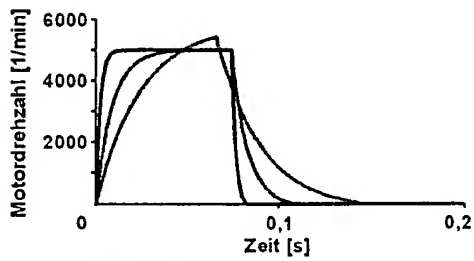
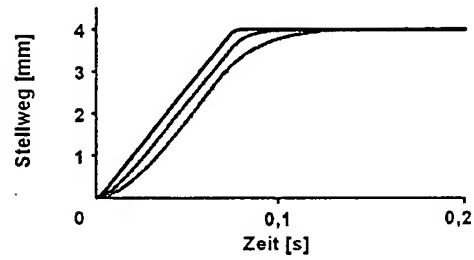


Figur 201





Figur 202

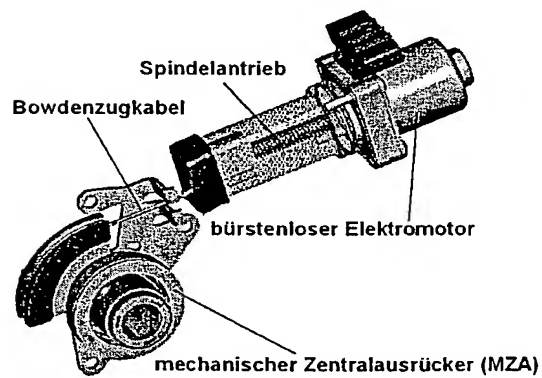
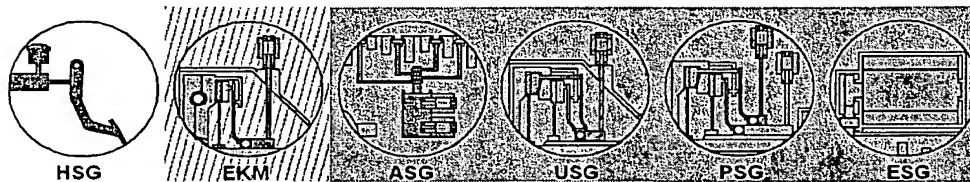


- neuer Motor (EC)
- heutiger Schaltmotor (DC)
- ... heutiger Kupplungsmotor (DC)

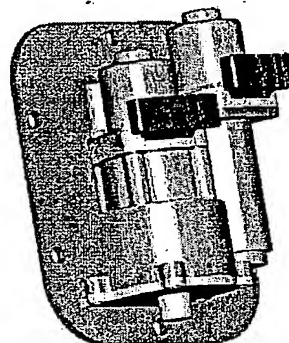
Figur 203

	heutiger Kupplungs- motor (DC)	heutiger Schaltmotor (DC)	neuer Motor (EC)
Leistungsdichte	101 W/kg 100%	163 W/kg 162%	267 W/kg 266%
Massenträgheit	$30,4 \cdot 10^{-6} \text{ kgm}^2$ 100%	$25,0 \cdot 10^{-6} \text{ kgm}^2$ 82%	$6,5 \cdot 10^{-6} \text{ kgm}^2$ 21%
mechanische Zeitkonstante	27,75 ms 100%	7,46 ms 27%	1,88 ms 6,8%
Gewicht	693 g 100%	813 g 117%	438 g 63%
Volumen	$166 \text{ cm}^3$ 100%	$162 \text{ cm}^3$ 98%	$62 \text{ cm}^3$ 37%

Figur 204

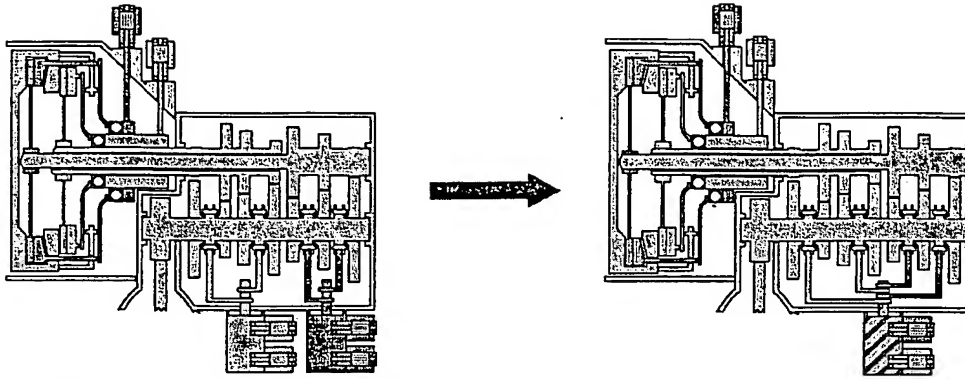


Kupplungsaktor

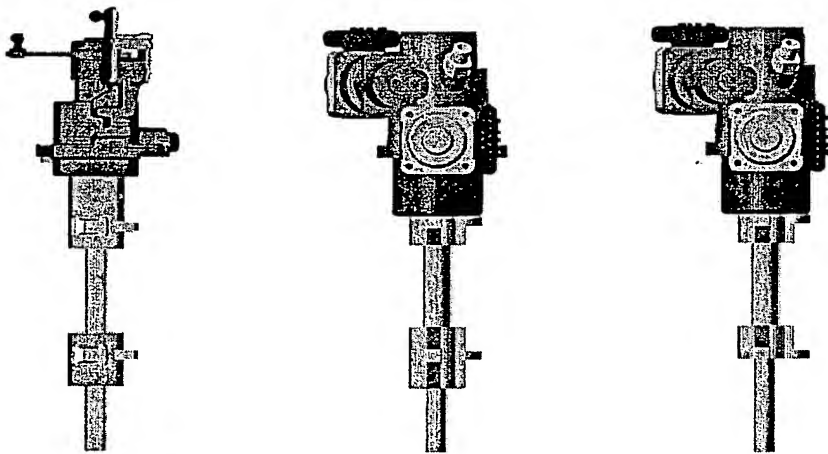
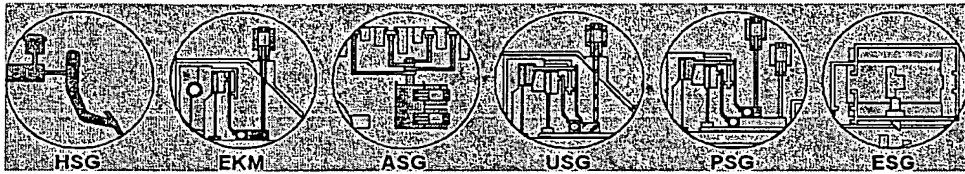


Getriebeaktor

Figur 205



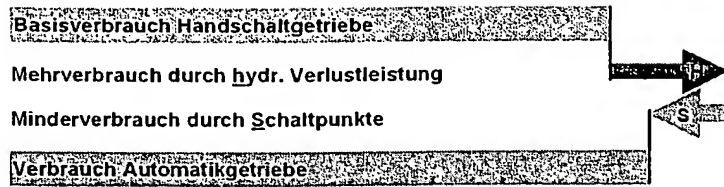
Figur 206



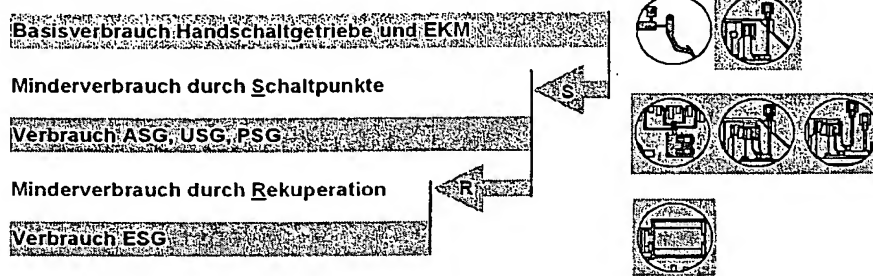
auf der Basis der neuen Elektromotoren

Figur 207

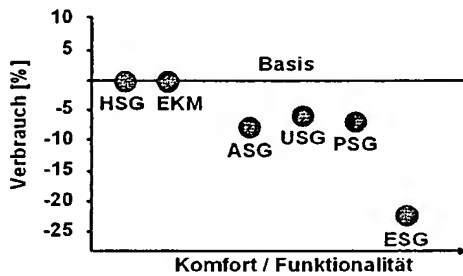
## Verbrauch Automatikgetriebe



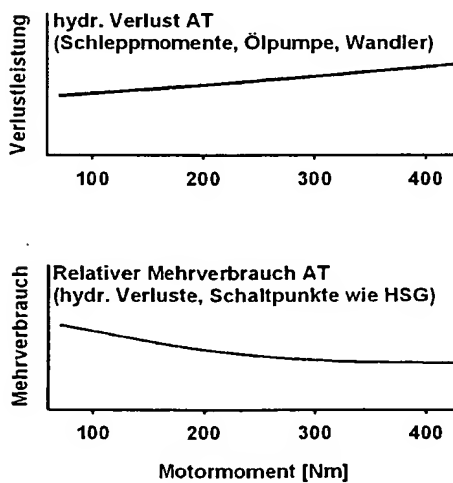
## Verbrauch XSG-Familie



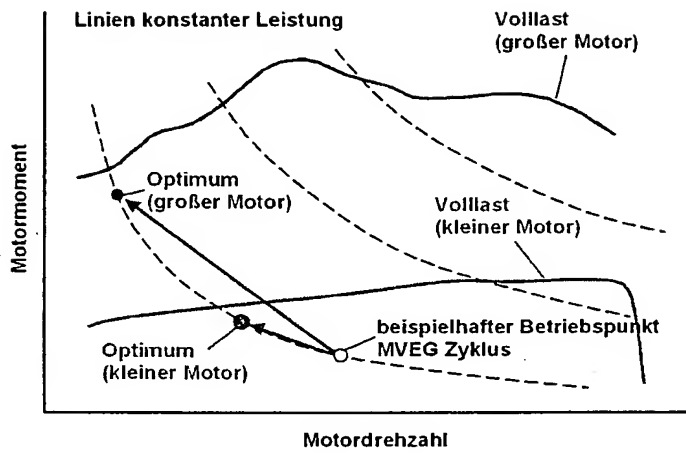
Figur 208



Figur 209

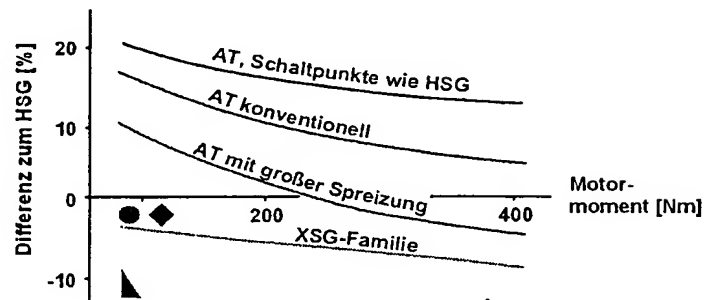


Figur 210



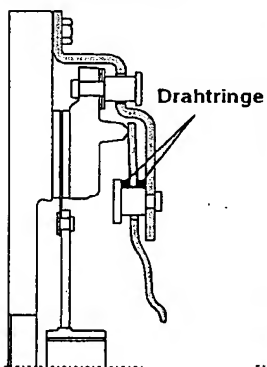
Figur 211

- Corsa 1.0 l
- ◆ Corsa 1.2 l
- ▲ Corsa 1.0 l Eco

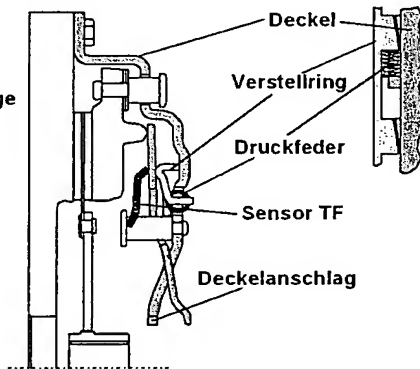


Figur 212

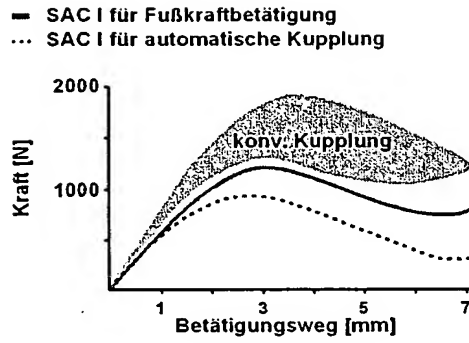
Konventionelle KD



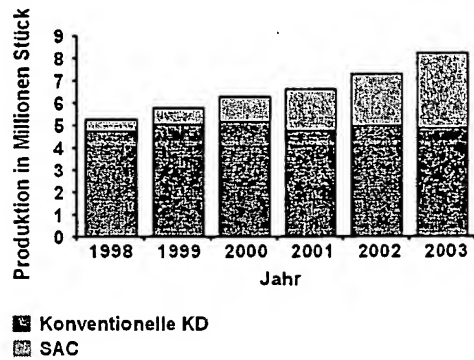
SAC



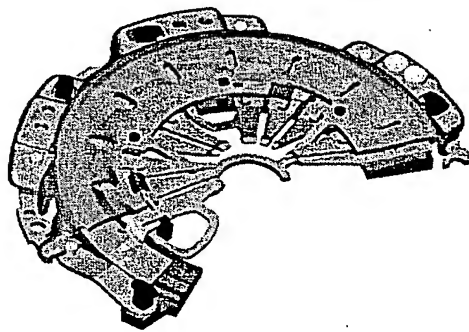
Figur 213



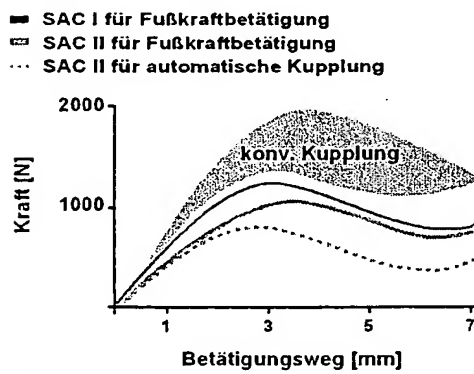
Figur 214



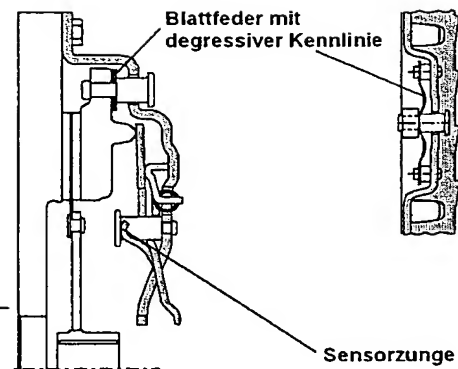
Figur 215

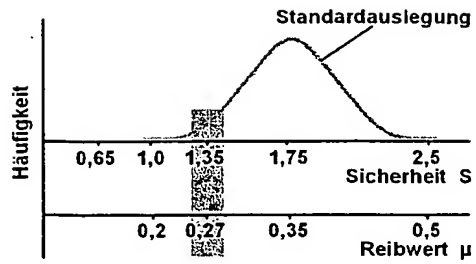


Figur 216

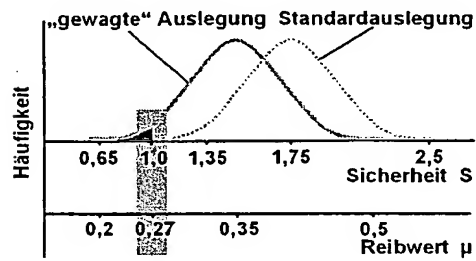


Figur 217



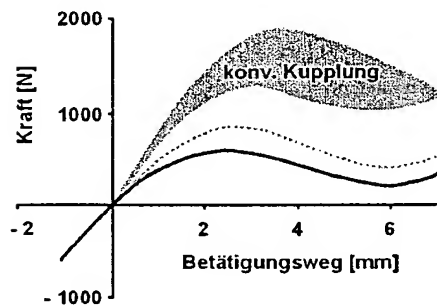


Figur 218



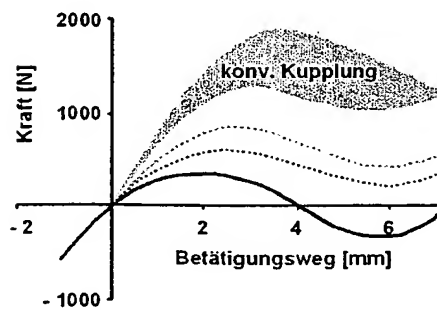
Figur 219

- ... SAC II
- SAC II mit 30% reduziertem Übertragungsmoment

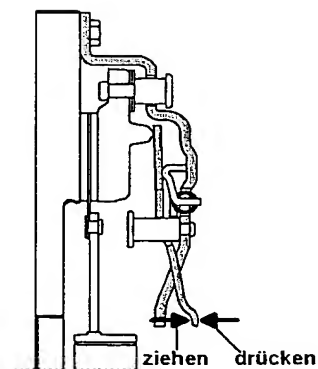
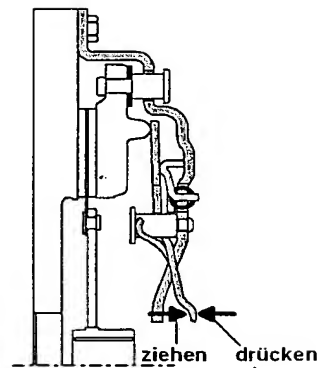


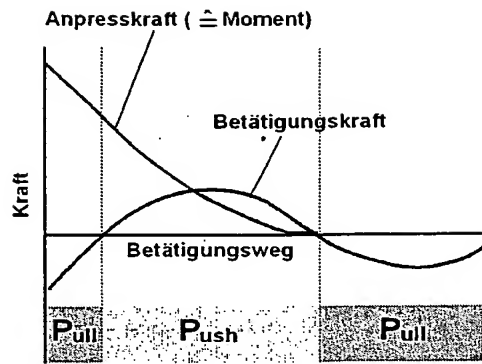
Figur 220

- ... SAC II
- ... SAC II mit 30% reduziertem Übertragungsmoment
- PPP Kupplung

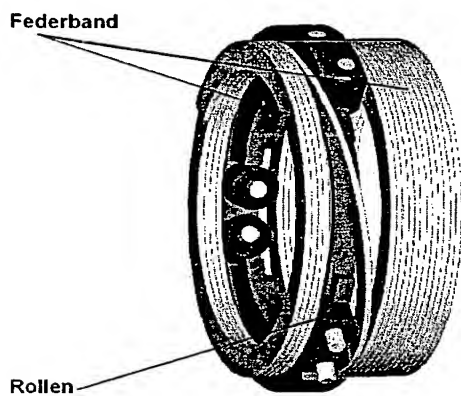


Figur 221

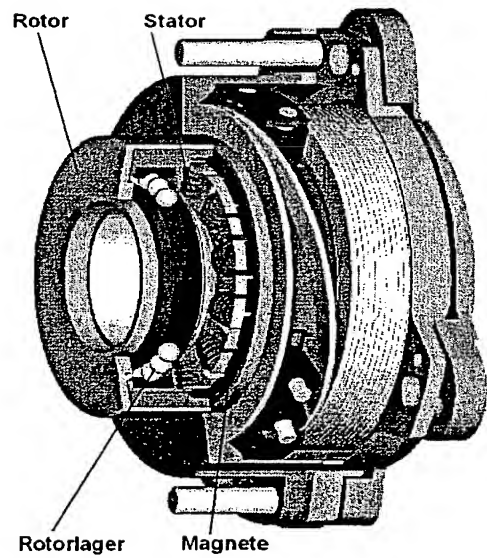




Figur 222

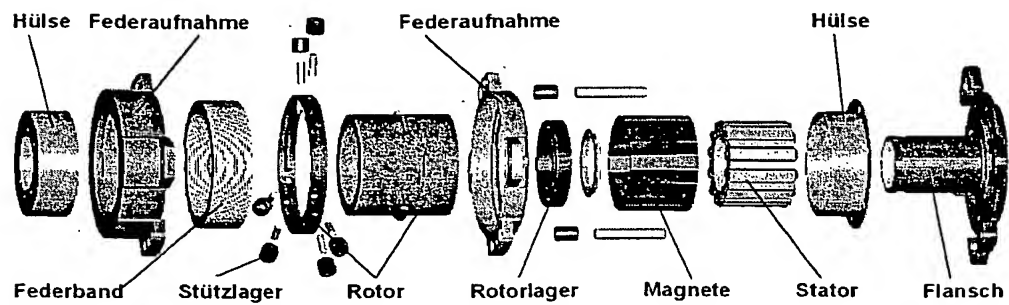


Figur 223

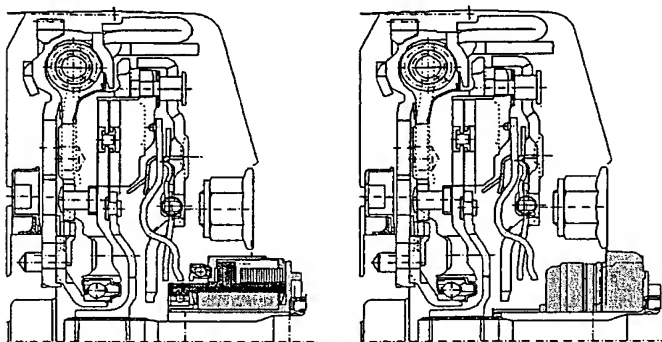


Figur 224





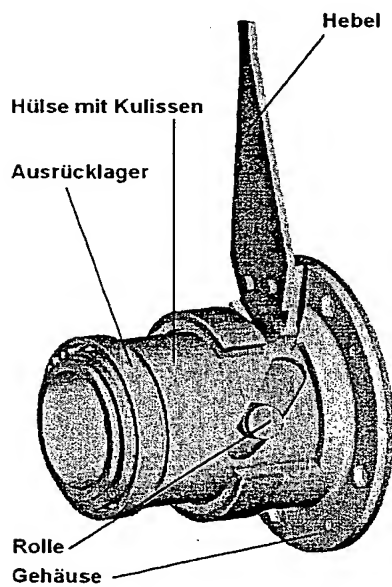
Figur 225



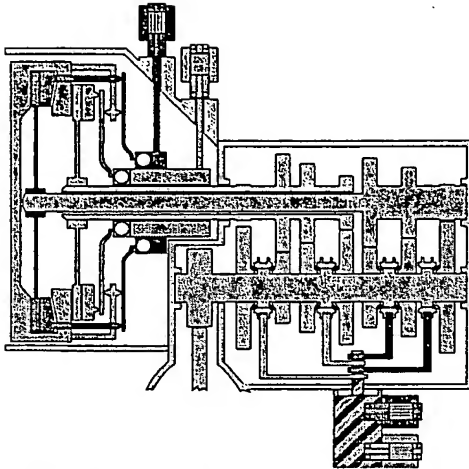
Kupplungsbetätigung  
mit integrierter Aktorik (EZA)

Serienstand mit CSC

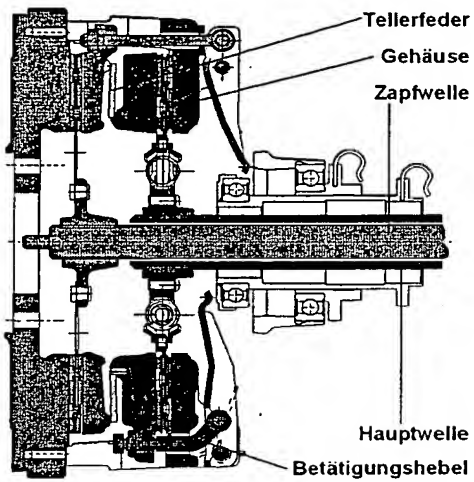
Figur 226



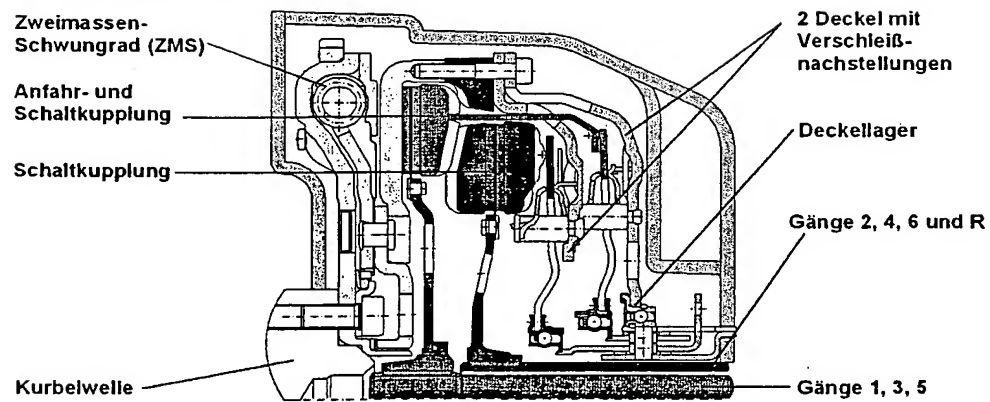
Figur 227



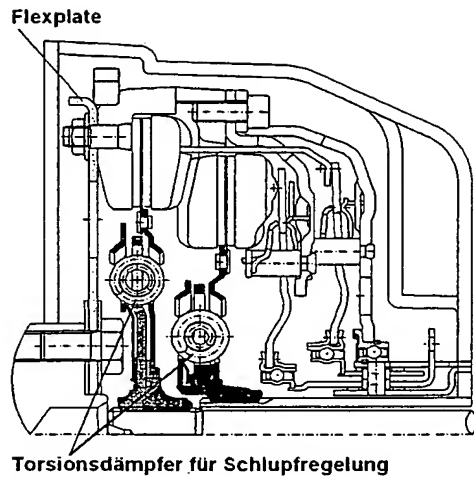
Figur 228



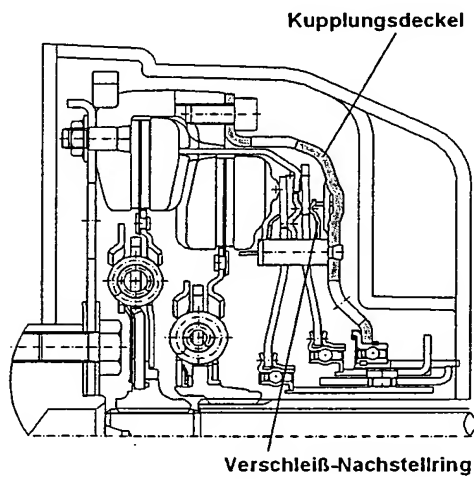
Figur 229



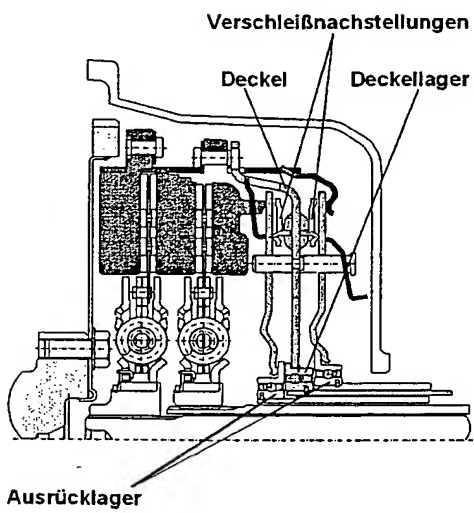
Figur 230



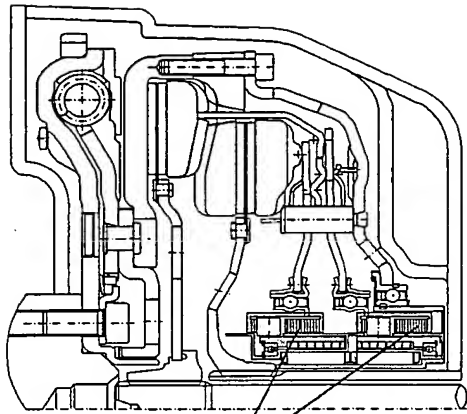
Figur 231



Figur 232

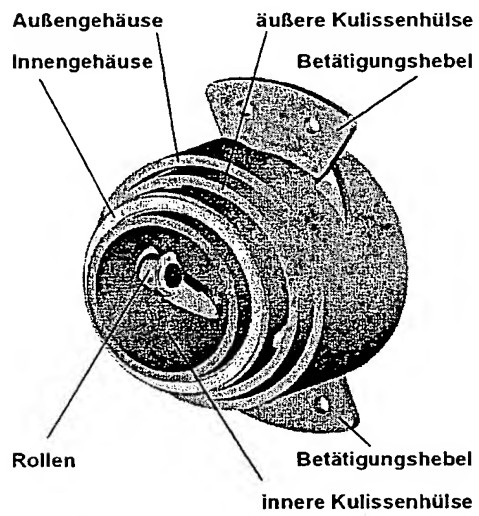


Figur 233

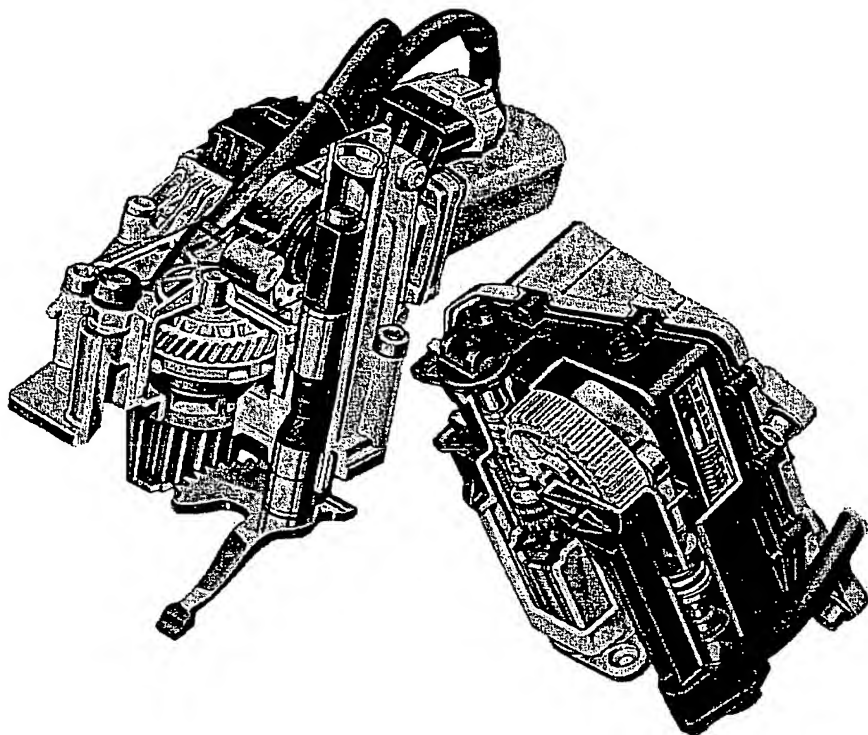


**Betätigung durch Doppel-EZA**

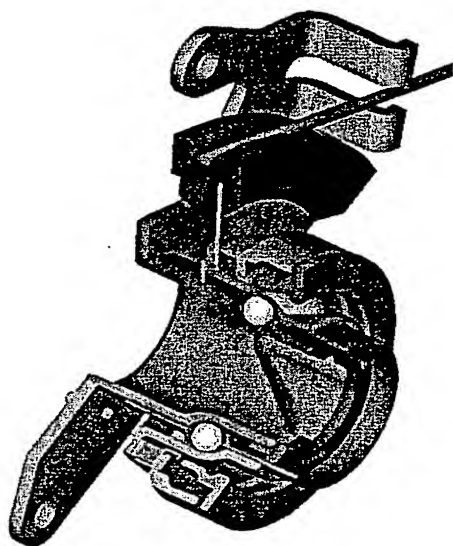
*Figur 234*



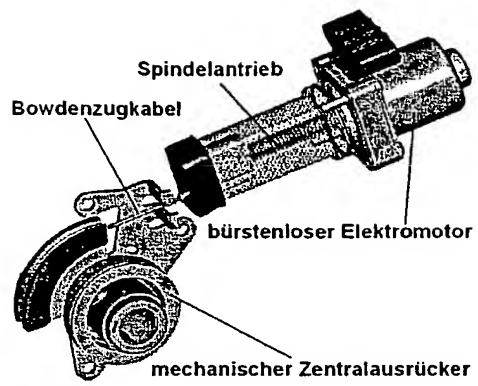
*Figur 235*



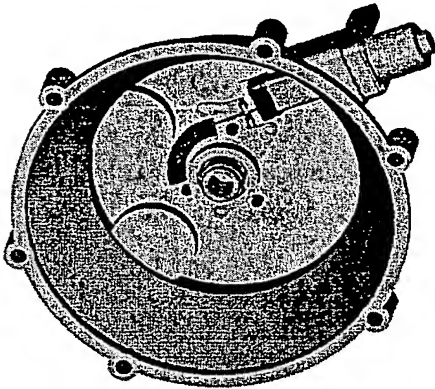
Figur 236



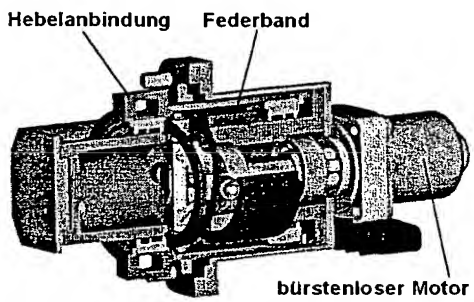
Figur 237



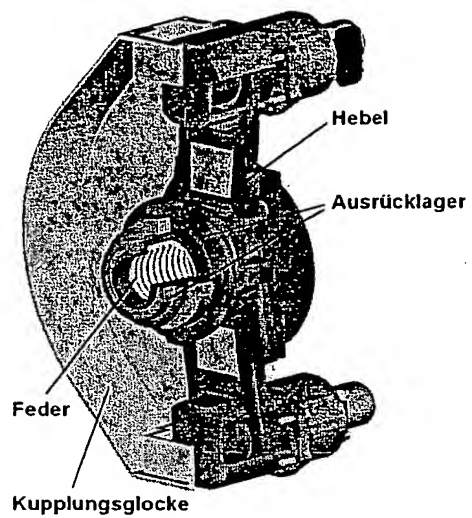
Figur 238



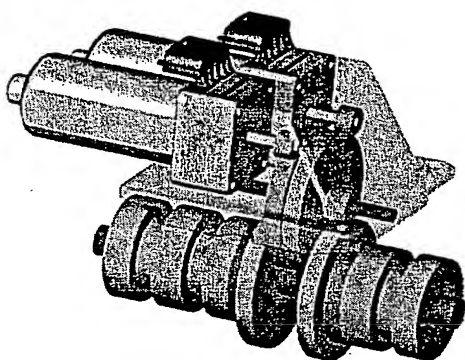
Figur 239



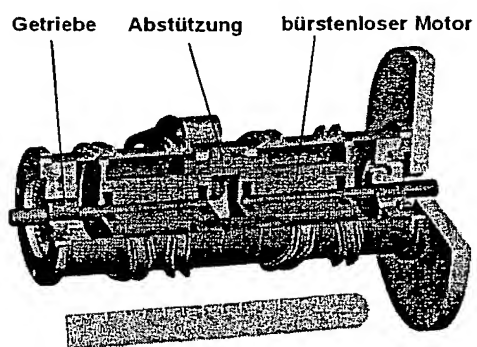
Figur 240



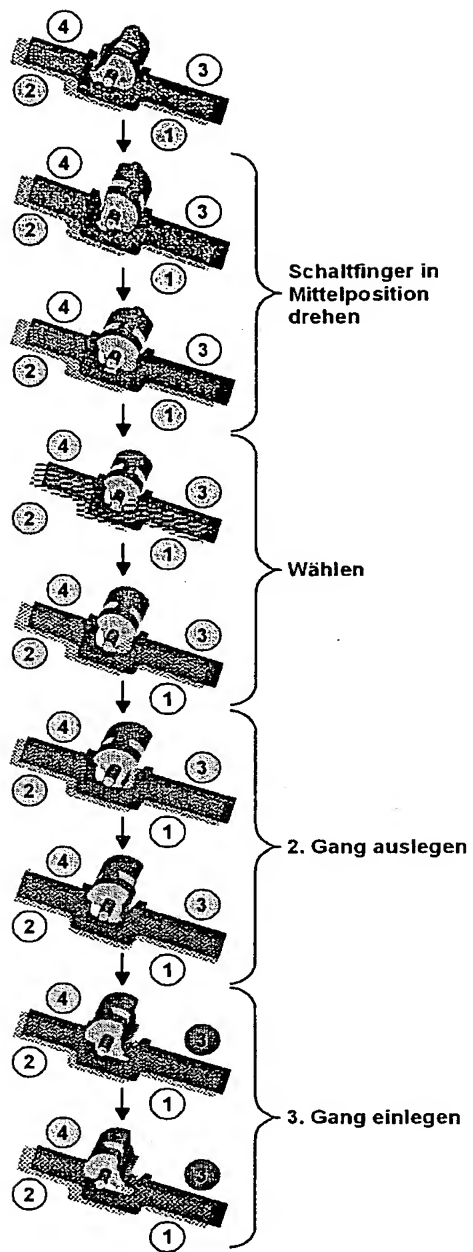
Figur 241



Figur 242

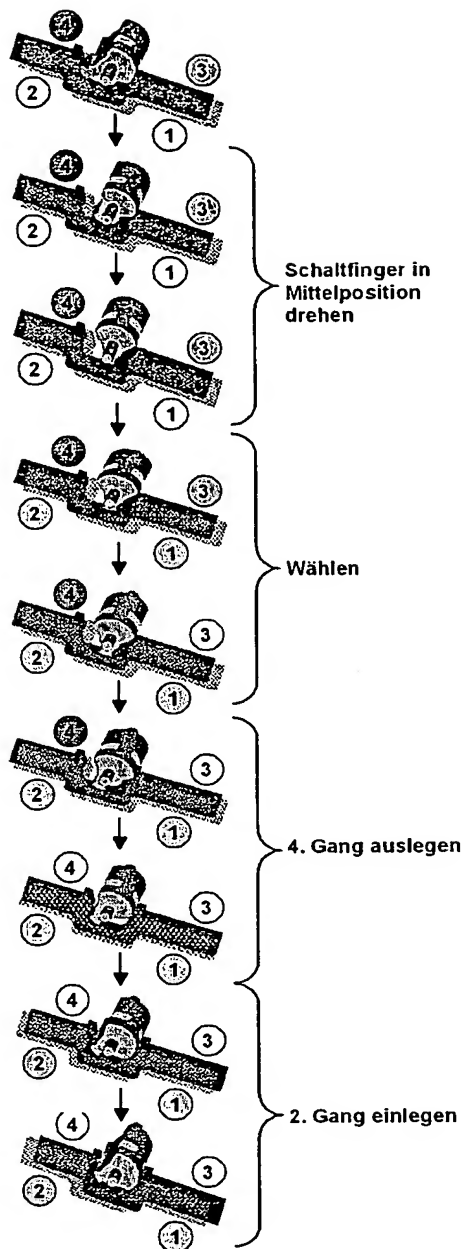


Figur 243

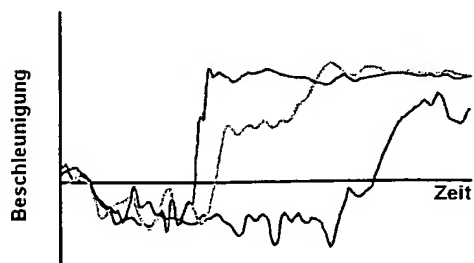


Figur 244



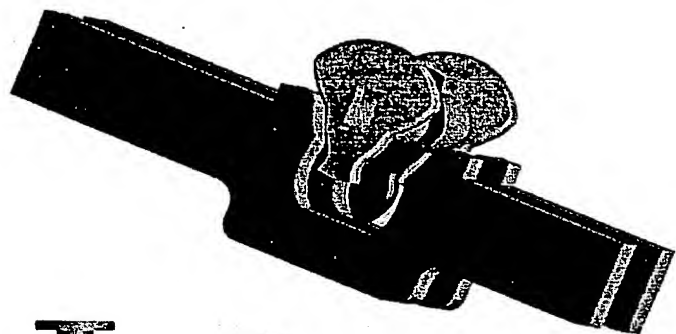


Figur 245



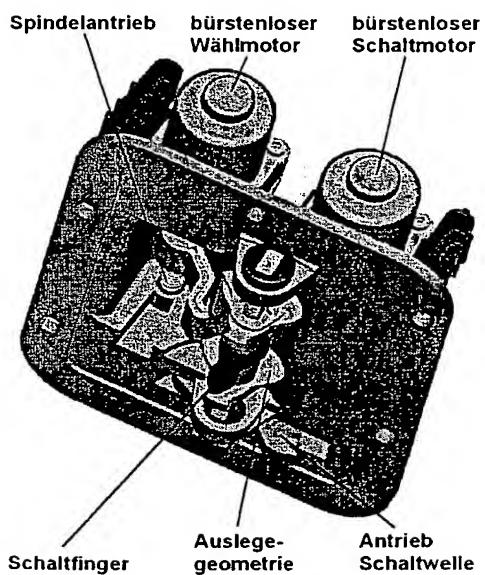
- LuK ASG mit Active Interlock 5 → 2
- - - LuK ASG 5 → 2
- ... Schaltwalze 5 → 3

Figur 246

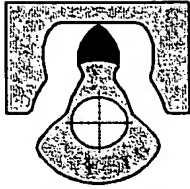


- Schaltschienen gerade Gänge      ■ Schaltfinger
- Schaltschienen ungerade Gänge    ■ Auslegegeometrien

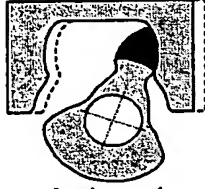
Figur 247



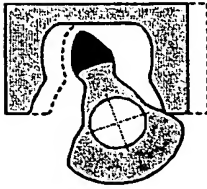
Figur 248



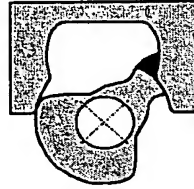
Mittelstellung



Auslegen 1

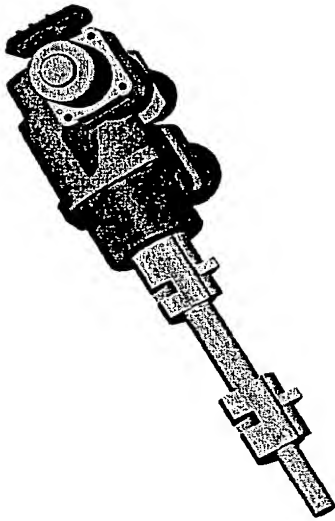


Auslegen 2

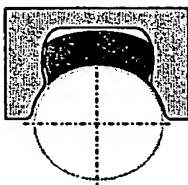


Sperren

Figur 249



Figur 250

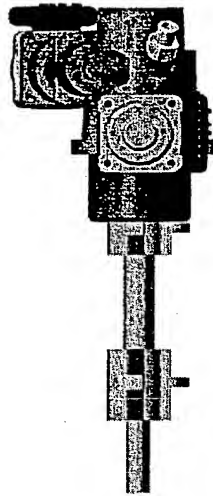


Figur 251

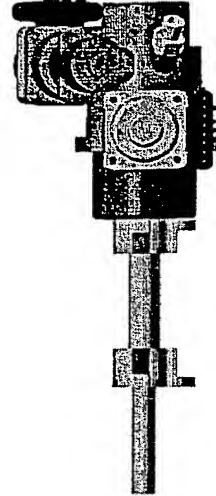
Handschaltgetriebe



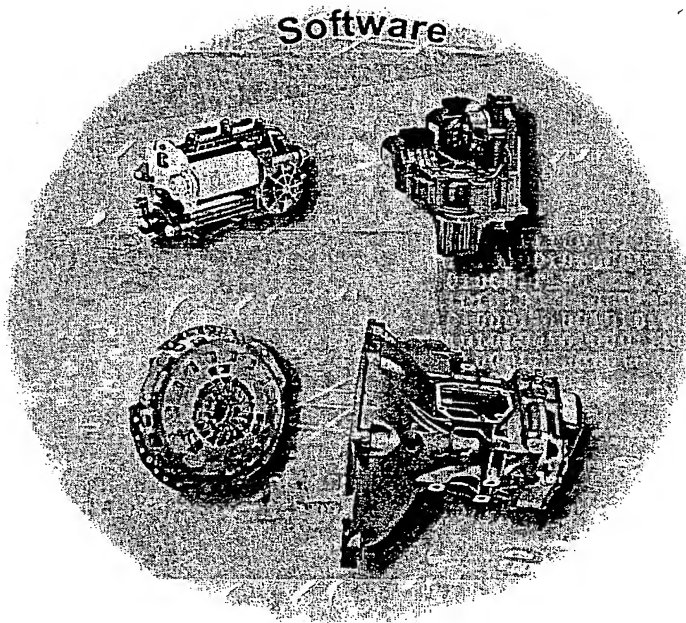
ASG mit Active Interlock



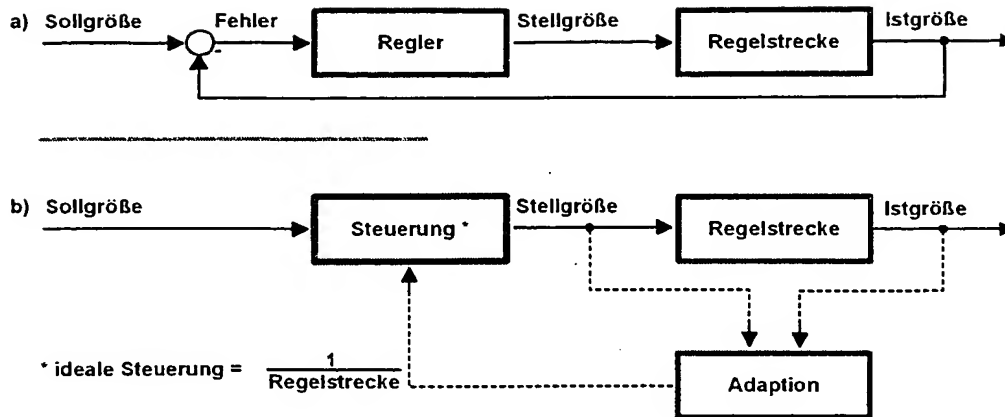
PSG mit Active Interlock



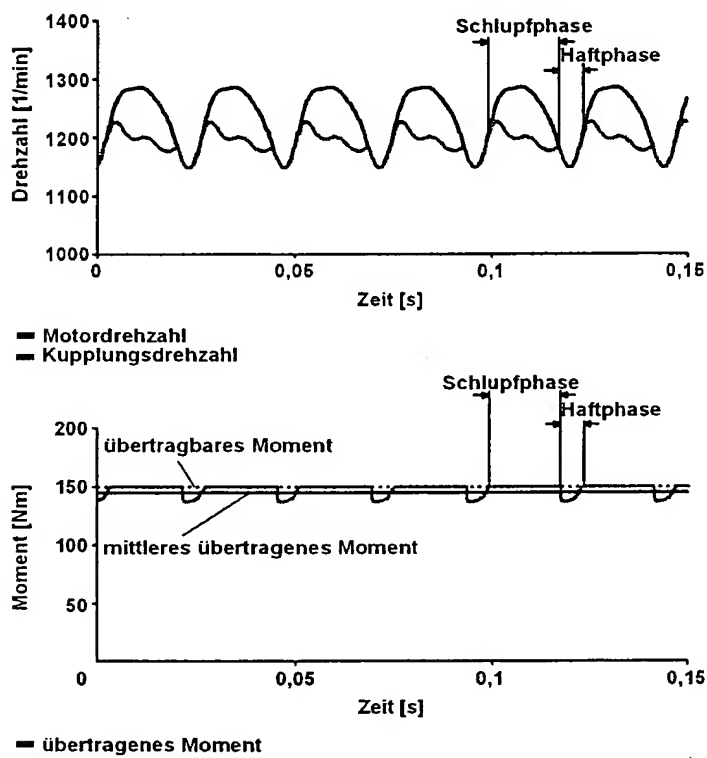
Figur 252



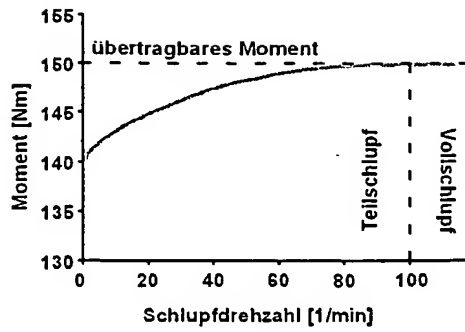
Figur 253



Figur 254

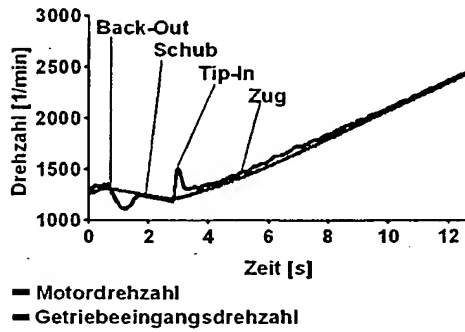


Figur 255

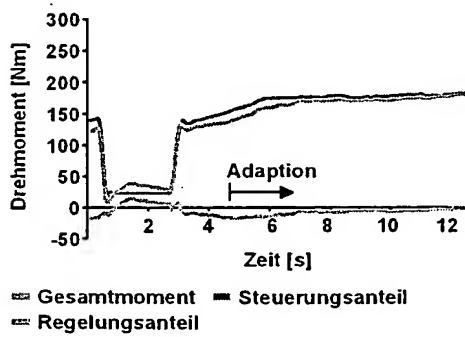


■ mittleres übertragenes Moment  
bei konstanter Anpresskraft

Figur 256

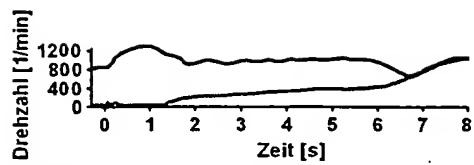


■ Motordrehzahl  
■ Getriebeeingangsdrehzahl

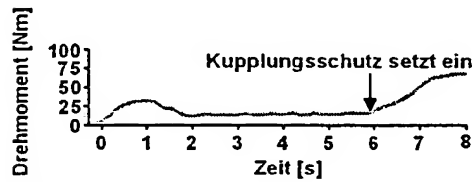


■ Gesamtmoment ■ Steuerungsanteil  
■ Regelungsanteil

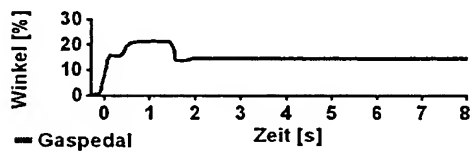
Figur 257



■ Motordrehzahl  
■ Fahrzeuggeschwindigkeit

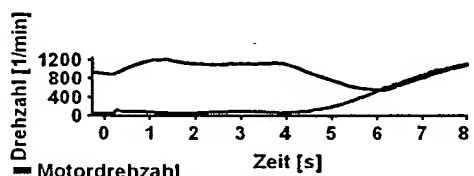


■ Kupplungsmoment

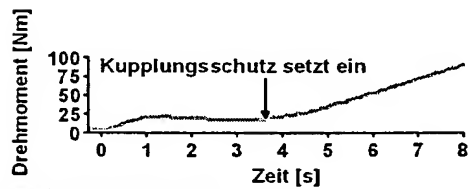


■ Gaspedal

Figur 258



■ Motordrehzahl  
■ Fahrzeuggeschwindigkeit



■ Kupplungsmoment

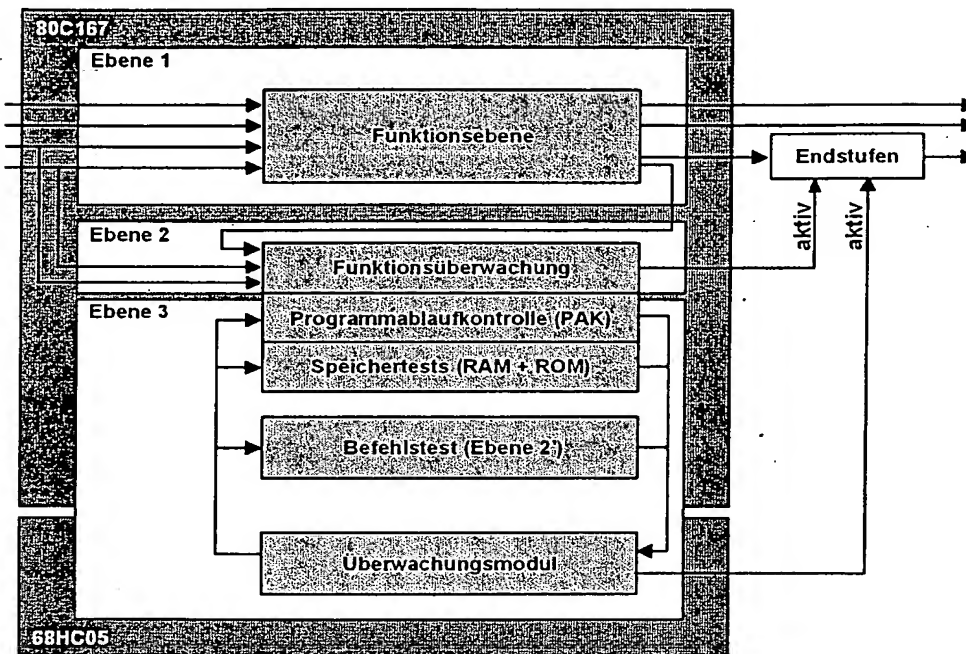


■ Gaspedal

Figur 259

		Situation		
		Geschlossen	Zwischenstellung	Geöffnet
Reaktion	Schließen	✓	?	⚡
	Öffnen	⚡	?	✓
	Stehenbleiben	✓	✓	✓

Figur 260

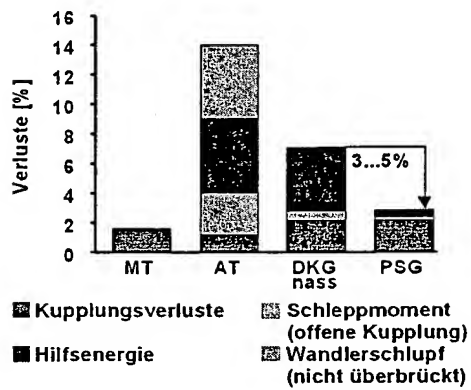


Figur 261

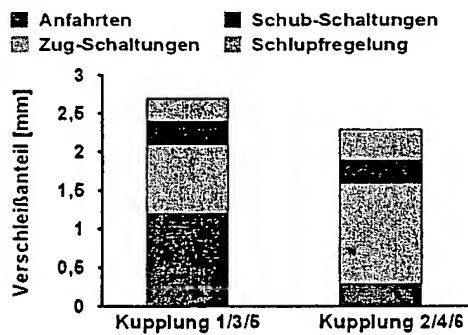


	Trocken- kupplung	Nass- kupplung
Verbrauch		
Überlastbarkeit Berganfahrten		
Option für modulare Familien		
Bauraum/ Gewicht		
Verhalten bei Ausfall		
Schaltqualität Regelbarkeit		

Figur 262

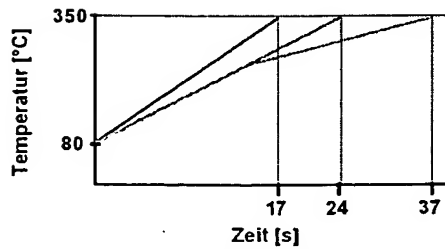


Figur 263



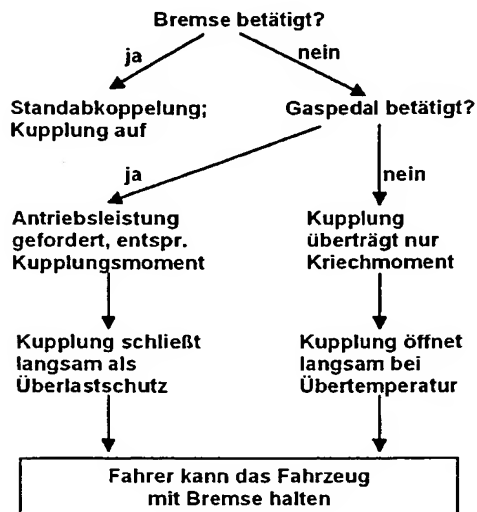
Fahrzeug 2000 kg  
 Motor 400 Nm  
 Kupplungen Durchmesser 250/220  
 Lebensdauer 240 000 km

Figur 264

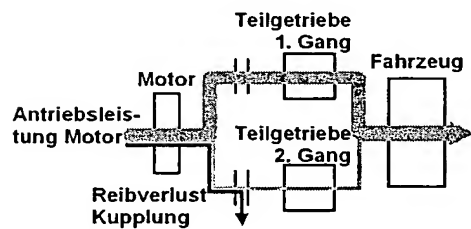


- Fall 1: 1. Gang wie Handschalter  
 Fall 2: 1. Gang 20% kürzer  
 Fall 3: Anfahren über beide Kupplungen

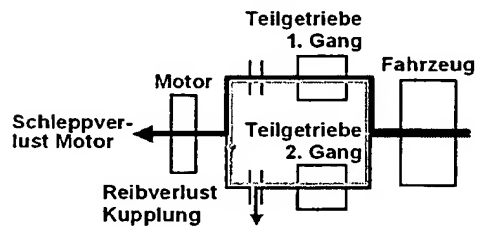
Figur 265



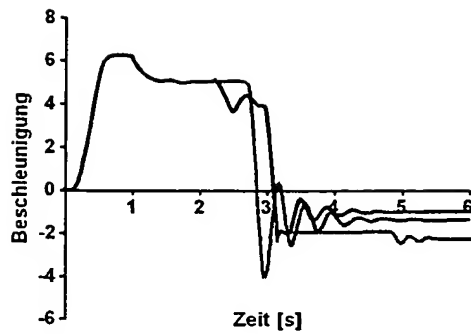
Figur 266



Figur 267

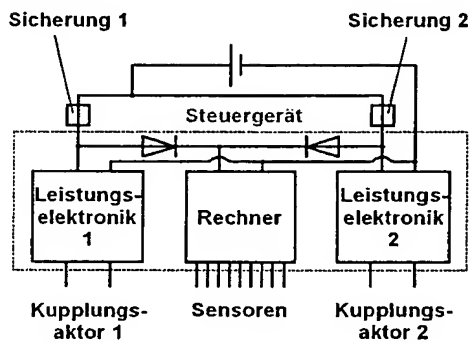


Figur 268

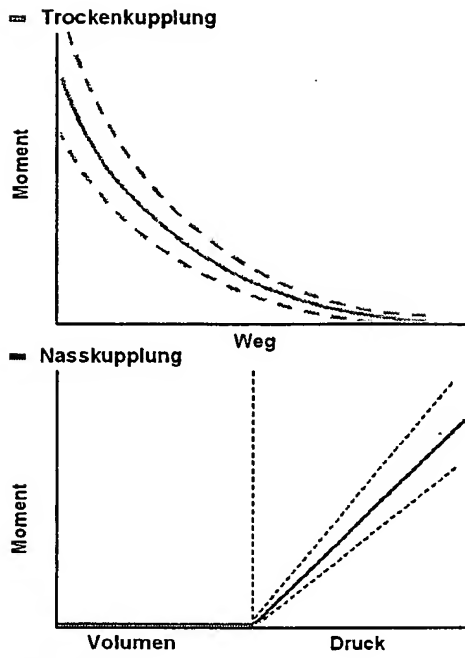


- 1. Gang: Zug  $\rightarrow$  Schub-Wechsel
- Ausfall bei 1  $\rightarrow$  2 Schaltung, danach Zug-Schub-Wechsel
- Ausfall bei 1  $\rightarrow$  2 Schaltung, danach Zug  $\rightarrow$   $M_{\text{mot}} = 0 \text{ Nm}$

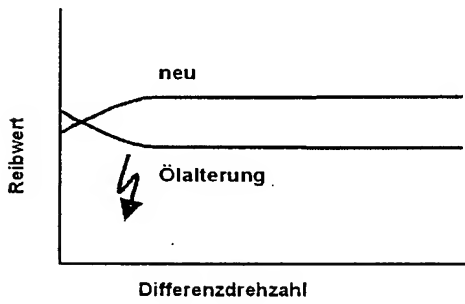
Figur 269



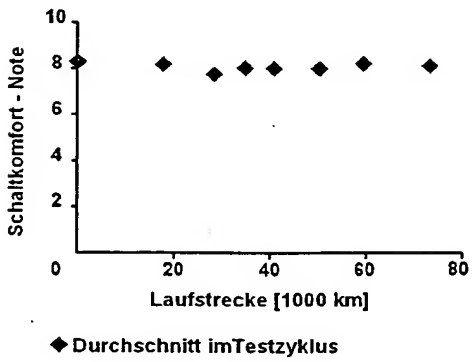
Figur 270



Figur 271

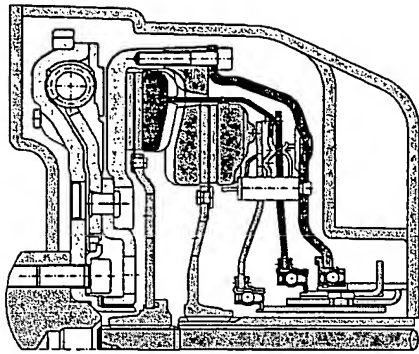


Figur 272



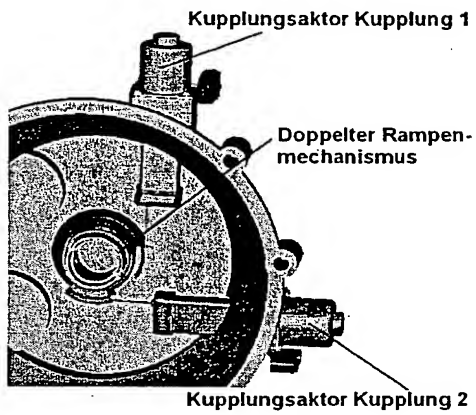
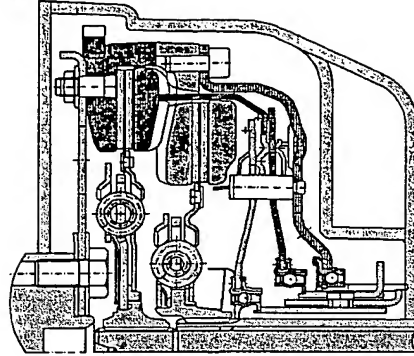
Figur 273

mit ZMS



Figur 274

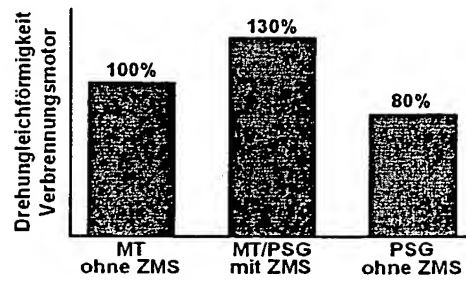
mit Flexplate



Figur 275

	ohne ZMS	mit ZMS
MT / ASG	0,2 kgm <sup>2</sup>	0,25 kgm <sup>2</sup>
PSG	0,25 kgm <sup>2</sup>	0,35 kgm <sup>2</sup>

Figur 276

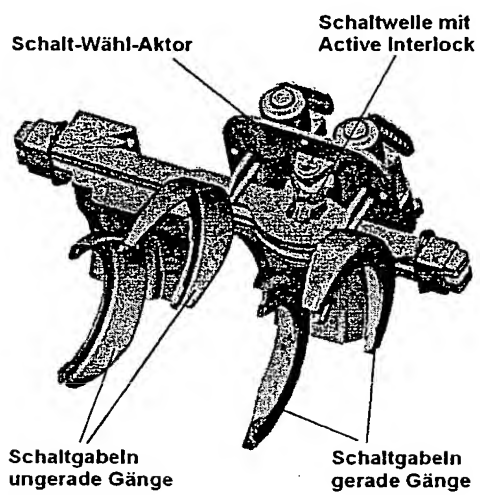


Figur 277

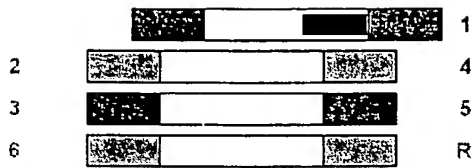
	Mehrverbrauch	
	Manueller Modus	Automatik Modus
Optimierung Motorbetriebspunkt	$\pm 0\%$	-5,0%
Reduktion Massenträgheit	-0,5%	-0,5%
Schlupfregelung	+0,5%	+1,0%
Bilanz	$\pm 0\%$	-4,5%

beispielhafter Durchschnittswert

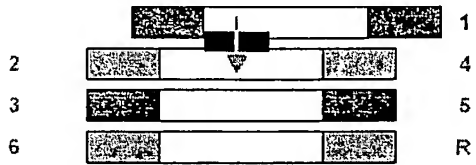
Figur 278



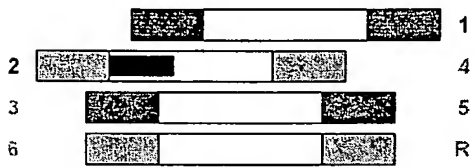
Figur 279



1. Schritt: Gang 1 einlegen

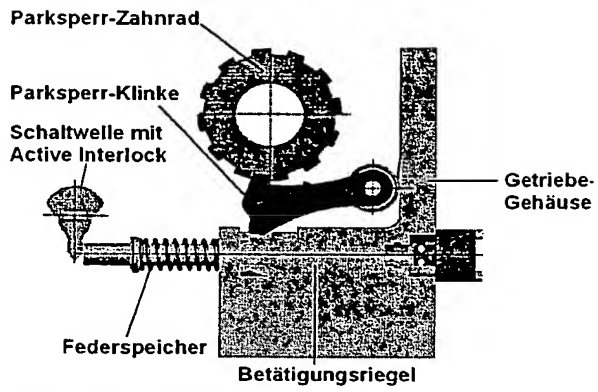


2. Schritt: wählen

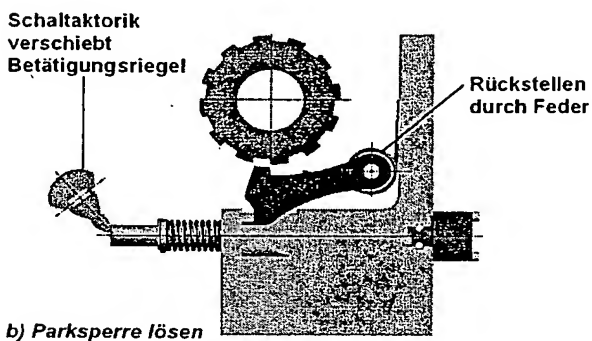


3. Schritt: zusätzlich Gang 2 einlegen

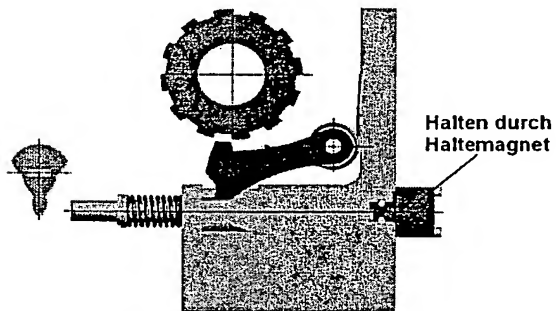
Figur 280



a) Parksperr-Zahnrad betätigt

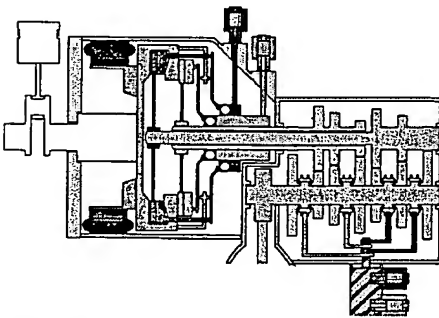


b) Parksperr-Zahnrad lösen



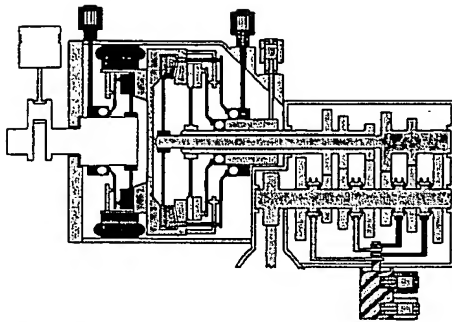
c) Parksperr-Zahnrad offen halten

Figur 281

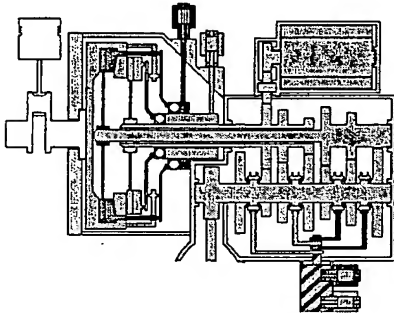


Figur 282

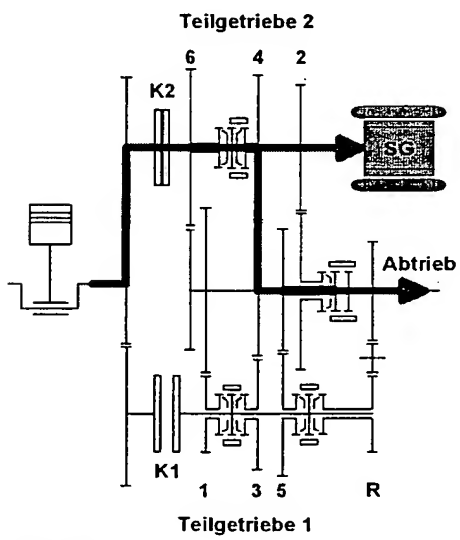




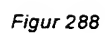
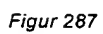
Figur 283

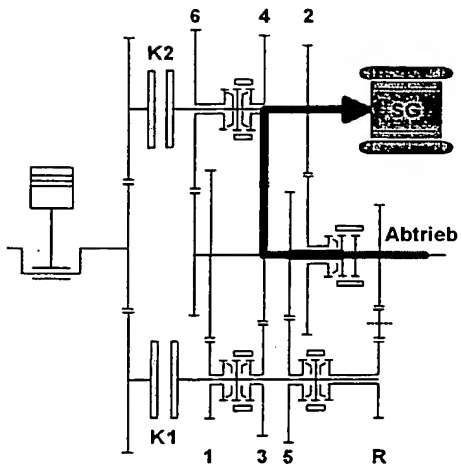


Figur 284

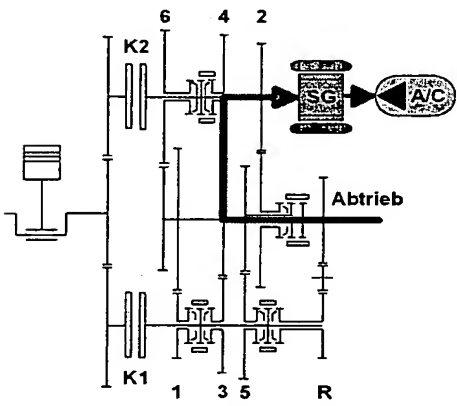


Figur 285

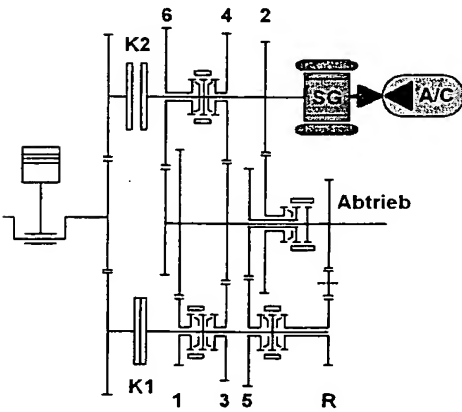




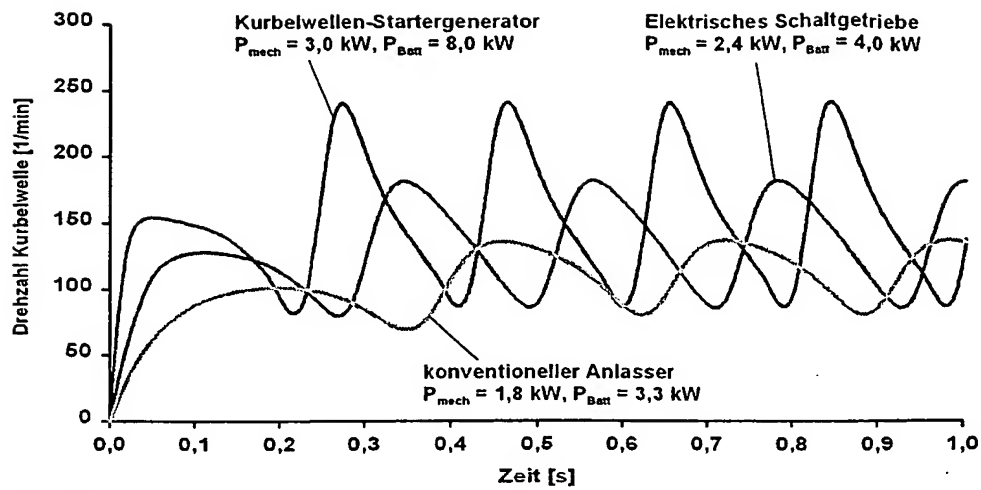
Figur 289



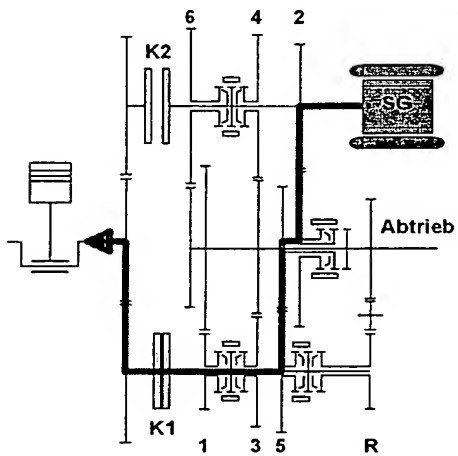
Figur 290



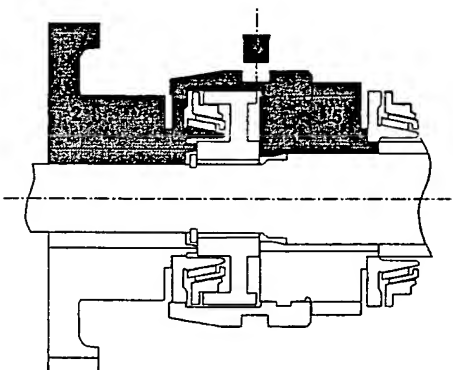
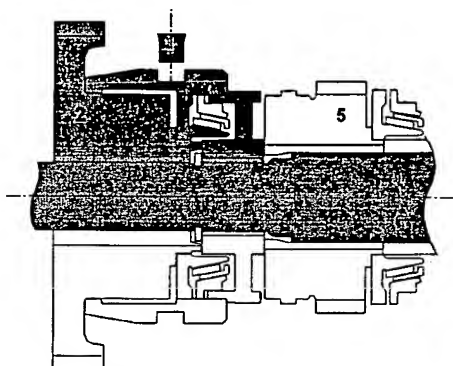
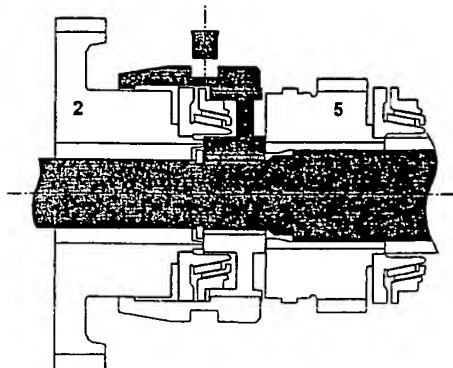
Figur 291



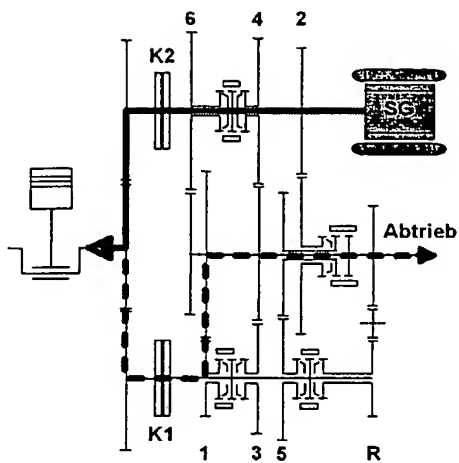
Figur 292



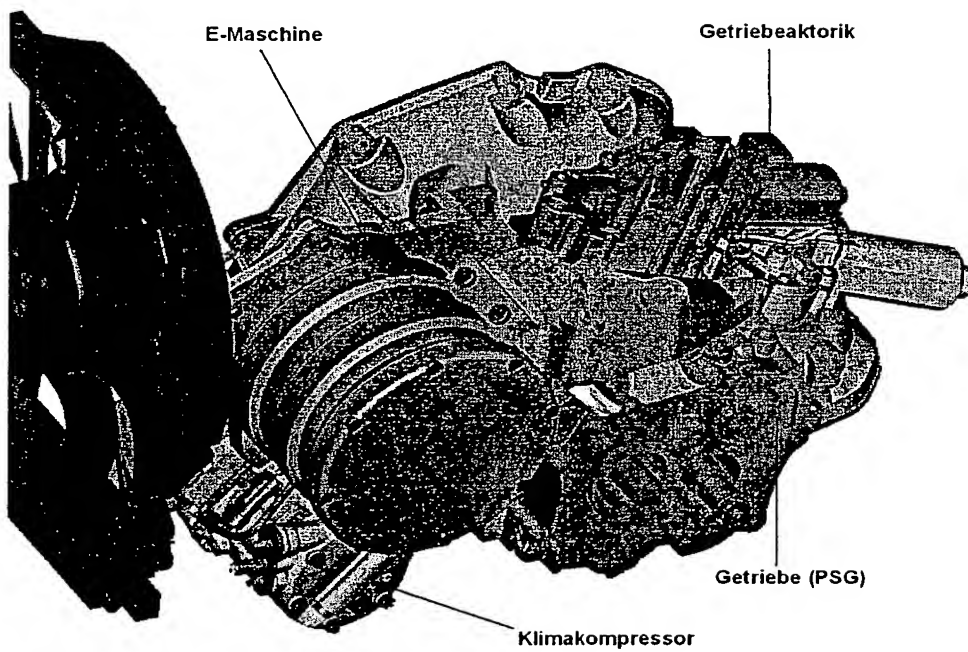
Figur 293



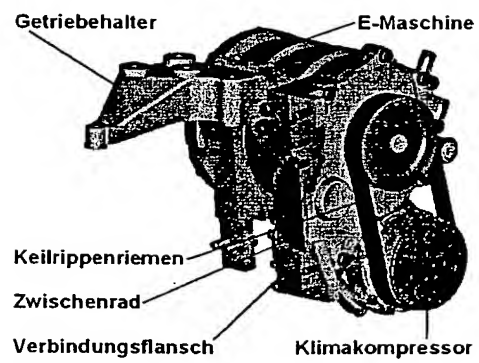
Figur 294



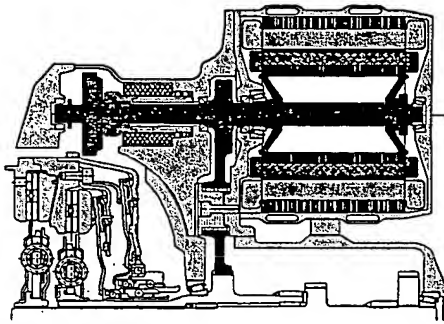
Figur 295



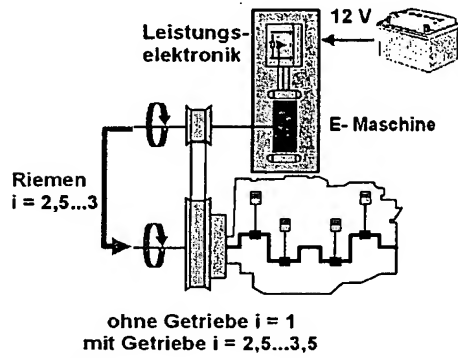
Figur 296



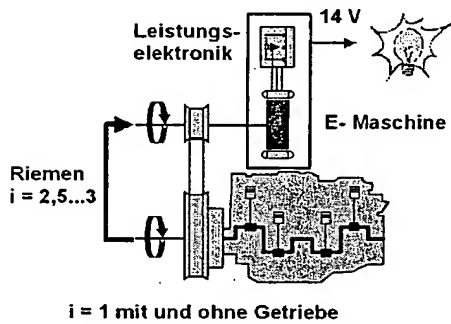
Figur 297



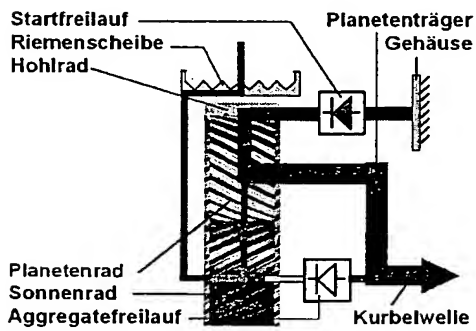
Figur 298



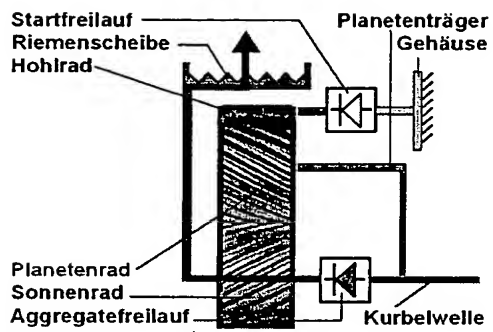
Figur 299



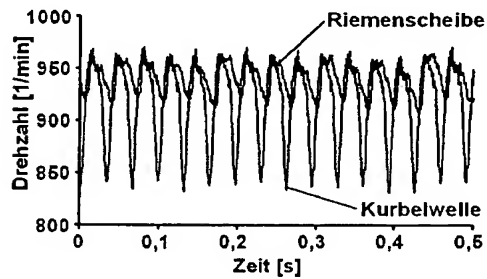
Figur 300



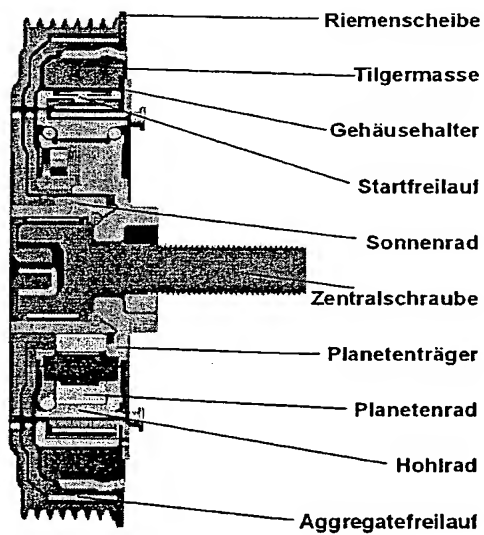
Figur 301



Figur 302

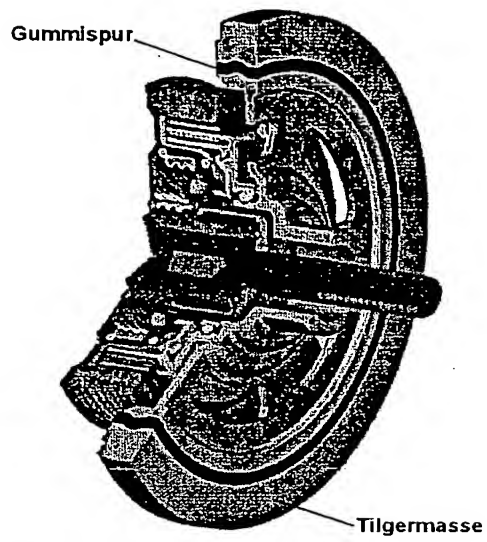


Figur 303



Figur 304





Figur 305

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